

CCFFR SCL 2019

*Resilience, Adaptation, and Mitigation
Strategies for Conserving Canada's
Aquatic Resources*

January 3-6, London, Ontario

Sponsors



Fisheries and Oceans Canada / Pêches et Océans Canada



Société canadienne de Limnologie



Table of Contents

| | |
|---|------------|
| Sponsors | 2 |
| Welcome Statement | 4 |
| Code of Conduct Statement | 4 |
| Conference Venue Map | 5 |
| Key Locations Map | 6 |
| Important Presenter Information | 7 |
| Conference Schedule | 8 |
| Invited Plenaries | 23 |
| Panel Discussion : Tips to get a job in Aquatic Sciences | 25 |
| Symposia | 27 |
| Poster Presentations | 30 |
| Abstracts | 35 |
| Registrants by Gender | 130 |

Welcome Statement

On behalf of the local organizing committee, we welcome you to London and the 2019 joint meeting of the Canadian Conference on Freshwater Fisheries Research & the Society of Canadian Limnologists. We have a packed scientific program with invited plenaries, eight symposia, and general contributions organized by topic. Altogether there are over 180 contributed talks and 50 posters. Posters can be viewed any time between 1 pm Friday and the end of the conference. A number of generous sponsors have helped make this meeting possible, so be sure to stop by their booths on the second floor. There are also several social events and networking opportunities that you will not want to miss. We hope you enjoy the conference!

Bryan Neff
Yolanda Morbey
Carlie Muir
Shawn Garner

Code of Conduct Statement

The organizers are committed to making this meeting productive and enjoyable for everyone, regardless of gender, sexual orientation, disability, physical appearance, body size, race, nationality or religion. We will not tolerate harassment of participants in any form. Please follow these guidelines:

Behave professionally. Harassment and sexist, racist, or exclusionary comments or jokes are not appropriate. Harassment includes sustained disruption of talks or other events, inappropriate physical contact, sexual attention or innuendo, deliberate intimidation, stalking, and photography or recording of an individual without consent. It also includes offensive comments related to gender, sexual orientation, disability, physical appearance, body size, race or religion.

All communication should be appropriate for a professional audience including people of many different backgrounds. Sexual language and imagery is not appropriate.

Be kind to others. Do not insult or put down other attendees.

Participants asked to stop any inappropriate behaviour are expected to comply immediately. Attendees violating these rules may be asked to leave the event at the sole discretion of the organizers without a refund of any charge.

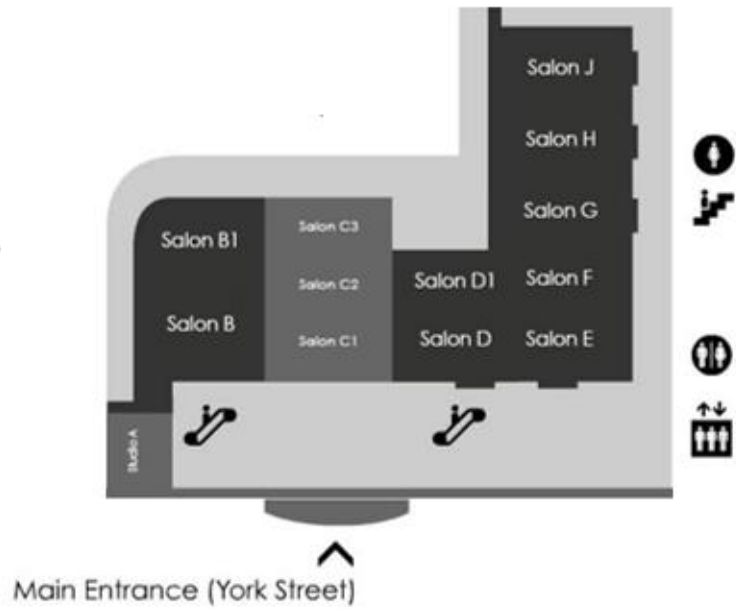
Any participant who wishes to report a violation of this policy is asked to speak, in confidence, to any of the conference organizers.

This code of conduct is based on the "London Code of Conduct", as originally designed for the conference "Accurate Astrophysics. Correct Cosmology", held in London in July 2015.

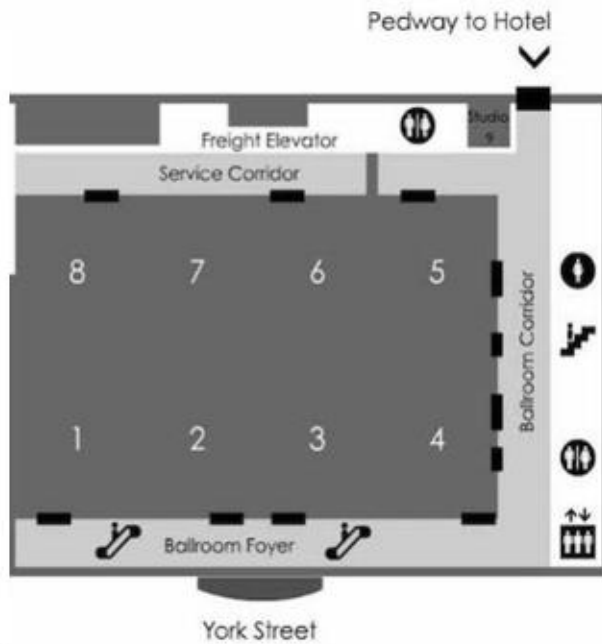
Conference Venue

London Convention Centre
300 York Street,
London, Ontario
N6B 1P8

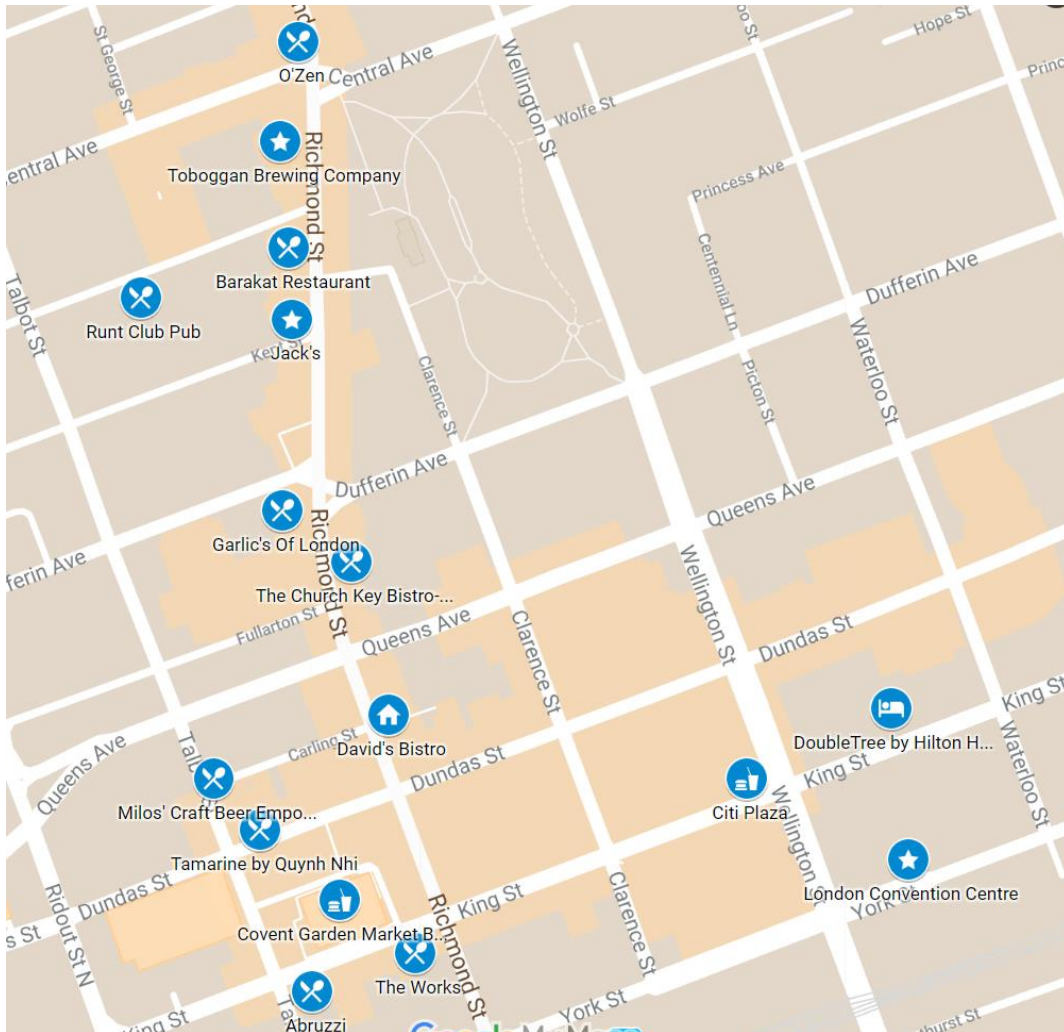
1st Floor



2nd Floor



Key Locations



Main Venue: London Convention Centre

Opening Mixer: Toboggan Brewing Company

Student Mixer: Jack's

Downtown Restaurants (Lunch options): Citi Plaza, Covent Garden Market (Food court and restaurants)

Downtown Restaurants (Dinner Options): The Church Key Bistro, Garlic's of London, David's Bistro, Tamarine by Quynh Nhi, Milo's Craft Beer, Abruzzi, The Works, Barakat Restaurant, Toboggan Brewing Company Pub, The Runt Club, Ozen

Important Presenter Information

Oral presentations will be 20 minutes in length (15-minute talk + 5 minutes for questions). The projector will be connected to a Windows PC, so slides should be in either Powerpoint or PDF format. Please use a widescreen (16:9) slide orientation and avoid using proprietary fonts. Presenters are asked to bring their presentations on a USB memory key and load them onto the computer in the their presentation room at least 30 minutes prior to the start of their session.

Posters should be a maximum of 44" x 44" (112 cm x 112 cm) in size. Adhesives dots will be provided to attach posters to the poster boards. Posters should be posted by 1 pm on Friday, January 4th and must be removed by 1 pm on Sunday, January 6th.

Conference Schedule

| Thursday, Jan 3, 2019 | |
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| 16:00-19:30 | Registration (2 nd floor foyer) |
| 16:00-18:00 | Panel Discussion: Tips to get a job in Aquatic Sciences (Salon G). Pre-registration required. |
| 20:00-0:00 | Welcome Social (Toboggan Brewing Company - 585 Richmond St; food provided). |

| Friday, Jan 4, 2019 | | | | | |
|---------------------|---|--|--|--|--|
| 8:00-10:00 | Registration (2 nd floor foyer) | | | | |
| 9:00-9:15 | Opening remarks & welcome – Yolanda Morbey, Bryan Neff, Margaret Docker, Jérôme Marty (Ballroom 4) | | | | |
| 9:15-10:15 | J.C. Stevenson Memorial Lecture , with introduction by Jong Chen (Editor-in-Chief, CJFAS) (Ballroom 4) Recipient - Sean Anderson | | | | |
| 10:15-10:45 | Nutrition break (2 nd floor foyer) | | | | |
| 10:45-10:50 | Robert Peters Award Announcement - Jérôme Marty (President, SCL) (Ballroom 4) Recipient - Marie-Eve Monchamp | | | | |
| 10:50-11:50 | Frank Rigler Memorial Award Lecture , with introduction by Jérôme Marty (President, SCL) (Ballroom 4) Recipient - Bernadette Pinel-Alloul | | | | |
| 11:50-13:20 | Executive Meeting CARS-AFS (Salon D) | | | | |
| 11:50-13:20 | Lunch (on your own) | | | | |
| | <i>Limnology at the Landscape Level: Integrating Multiple Stressors and Scales</i> (Salon E) | <i>Impacts of Climate Change in Aquatic Ecosystems</i> (Salon F) | <i>Showcase of Early Career Women in Aquatic Ecology & Conservation Research</i> (Salon G) | <i>Miles Keenleyside Symposium</i> (Salon H) | <i>Thermal Biology</i> (Salon J) |
| 13:20-13:40 | Investigating ecosystem responses to multiple interacting anthropogenic stressors in McLaughlin Bay | The role of climate and lake size in regulating the phenology of ice-cover Higgins, S.N.*, Desjardins, C., Drouin, H., | Coping with the cold: the winter ecology of freshwater fishes McMeans, B.C. *, Fernandes, T. | Recognizing Miles Keenleyside - 2019 Noakes, D. L. G. | The winter munchies: Feeding throughout winter is common in juvenile Pumpkinseed and improves energy |

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| | (Oshawa, Ontario) Hoskin, G.N.*; Korosi, J.B.; Kirkwood, A.E.; Thienpont, J.R. | Hrenchuk, L., van der Sanden, J. | | | reserves available in spring Rooke, A.C.*; Fox, M.G. |
| 13:40-14:00 | Diatom community assemblages are controlled by light availability in deep, low- DOC lakes in northeastern Ontario Gushulak, C.A.C., and Cumming, B.F. | Are lakes browning or re- browning? Impact of atmospheric deposition and climate change on long-term lake-water organic carbon levels in Ontario lakes Meyer-Jacob, C.*, Labaj, A.L., Paterson, A.M., Michelutti, N., Cumming, B.F., Keller, W., Smol, J.P. | Freshwater Aquatic Ecosystem Classification in Ontario and Beyond: Room for Conservation Melles, S.J.*, Chu, C., Jones, N.E., Schmidt, B. | Relative sexual attractiveness and social associations among males in a fission-fusion fish society Godin, J.-G.J.* | Fish in hot water: Maternal stress may prepare juvenile Chinook salmon offspring to behaviourally cope under climate change Warriner, T.R.*; Love, O.P.; Pitcher, T.E.; Semeniuk, C.A.D. |
| 14:00-14:20 | The response of colonizing and established communities of periphyton across a land-use gradient in the Lake Simcoe watershed MacKay, S.E.*, Kirkwood, A.E. | Can we track the effect of warming on the cladoceran communities of minimally-impacted lakes? Barouillet C., Meyer- Jacob C., Mushet G. R., Hennesy S., Bertin A., Cumming B. F. | Considering ecosystem connectivity: insights from the ecology and life history of three northern fishes Swanson, H.K.*, Baker, L.F., DeJong, R.A., Lord, S.I., and Smith, R. | Mate choice of hatchery and wild coho salmon Auld, H.L.*; Jacobson, D.P.; Banks, M.A. | The effect of elevated rearing temperature on thermal performance and cardiorespiratory morphology in Atlantic salmon (<i>Salmo salar</i>) Muir, C.A.*; Wise, R. A.; Damjanovski, S.; and Neff, B.D. |
| 14:20-14:40 | Flood-influenced lakes as archives of natural and anthropogenic trace metal deposition in the oil sands region: an approach to define pre- industrial baseline conditions Klemt, W.*; Hall, R.I.; Wolfe, B.B | Effects of photodegraded dissolved organic matter on phytoplankton Sherbo, B.*; Higgins, S.N.; Hann, B.J. | Sexual selection and alternative mating strategies in salmonid fishes Weir, L.K.* and Young, K.A. | An enduring legacy: 50 years of research into sunfish mating systems Neff, B.D.* | A tale of two strategies: Investigating how freshwater fish thrive in seasonal climates Fernandes, T.*; McMeans B. |

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| 14:40-15:00 | Landscape-scale drivers of nutrient concentrations in natural and artificial water bodies of the Northern Great Plains Finlay, K*; Webb, J.R.; Wissel, B.; Leavitt, P.R.; Baulch, H.M.; Simpson, G.L.; Haig, H.A; Hodder, K.R. | Effect of dissolved organic matter on red and green phenotypes of <i>Pseudanabaena</i> Chemali, C.*; Creed, I.F., Trick, C. G. | Inclusion and diversity in Canadian fisheries and aquatic sciences: time to reflect Semeniuk, C.A.D*; Madliger, C.L.; Melles, S.J.; Morbey, Y.E.; Febria, C.M. | An ethological analysis of expert Indigenous, Local and Science knowledge on White Shark (<i>Carcharodon carcharias</i>) mating in Aotearoa/New Zealand Crawford, S.S. | |
| 15:00-15:30 | Nutrition break (2 nd floor foyer) | | | | |
| | <i>Limnology at the Landscape Level: Integrating Multiple Stressors and Scales</i> (Salon E) | <i>Impacts of Climate Change in Aquatic Ecosystems</i> (Salon F) | <i>Genomics and eDNA Applications in Fisheries and the Conservation of Aquatic Ecosystems</i> (Salon G) | <i>Miles Keenleyside Symposium</i> (Salon H) | <i>Movement Ecology</i> (Salon J) |
| 15:30-15:50 | Drivers of water quality changes in North American lakes over the past 40 years Mahdiyan, O.*, Molot, L., Sapna, S. | The interactions between eutrophication and climate change on the role of inland aquatic systems in the global carbon cycle Prairie, Y.T. | Population hybridization outcomes are unrelated to population size and population divergence in Brook Trout Wells Z.R.R., Bernos T.A.*, Yates M.C., Fraser D.J. | Co-evolution of parental care and antipredator competence in convict cichlids Wisenden, B.D. | Seasonal spatial ecology of juvenile muskellunge and northern piker in St. Lawrence River nursery bays Walton-Rabideau. S.E.*; Ledee, E.J.I., Leblanc, J.P., Szekeres, P., Midwood, J., Gallagher, A.J., Farrell, J.M. and Cooke, S.J. |

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| 15:50-16:10 | Differential impacts of climatic variability and land-use on the 20th century algal pigment abundance among and within two temperate estuaries of Atlantic Canada Patoine, A.*; Karmakar, M.; Kurek, J. | Impact of glacial meltwater fluxes to carbon cycling dynamics in the Lake Hazen watershed of the Canadian high Arctic Dainard, P.*; Schiff, S.; Aukes, P.; Elgood, R.; St. Pierre, K.; St. Louis, V.; English, M.; Lehnerr, I. | Validation of the close kin mark recapture (CKMR) approach for the estimation of abundance in harvested, small, or data limited systems Ruzzante D.E.*; McCracken G.R., Førlund B., MacMillan J., Notte D., Mills Flemming J., Skaug H. | Can early life history traits predict juvenile migration timing in Chinook Salmon? Cogliati, K.M.*; Schreck, C.B., Noakes, D.L.G. | Migratory movements of adult Atlantic halibut in the southern Gulf of St. Lawrence James, T.L., LeBris, A., Landsman, S.J., van den Heuvel, M.R. |
| 16:10-16:30 | Paleolimnological assessment of nutrient and predation controls on cladoceran abundance and composition in four small fisheries lakes, interior British Columbia Mushet, G. R.*; Laird, K. R.; Leavitt, P. R.; Cumming, B. F. | Benthic assemblages as biological indicators of altered hydrological connectivity in a climate-sensitive delta floodplain - 5 years of monitoring lakes in the Mackenzie Delta, NT Scott, R.W.*; Tank, S.E., Wang, X., Quinlan, R. | Genetic divergence among sympatric resident and anadromous Arctic char (<i>Salvelinus alpinus</i>) in Labrador Salisbury, S.J.*; McCracken, G.R., Perry, R., Keefe, D., Koop, B.F., Nugent, C.M., Ferguson, M.M., Danzmann, R.G., Ruzzante, D.E. | Variation in antipredator armor among populations of Newfoundland threespine stickleback Biedak, N.R.; Scott, R.J.*; Baker, J.A.; Foster, S.A. | Science and Stewardship: Biomonitoring Namayo - Lake Sturgeon - In Northern Ontario Cruz-Font, L.*; Simard, J.; Isaac, B.; Cheechoo, J.; Louttit, S.; Struthers, D.; Chetkiewicz, C.; O'Connor, C. |
| 16:30-16:50 | Fish growth rates and lake sulphate control mercury levels in Ninespine stickleback (<i>Pungitius pungitius</i>) on the Arctic Coastal Plain of Alaska Burke, S.M.*; Branfireun, B.A.; Laske, S.M.; Zimmerman, C.E.; Swanson, H.K. | Investigating Landscape Drivers of Spatial Variability in Subarctic Lakes Responses to Permafrost Thaw Coleman, K.A.*; Korosi, J.B. | The effects of waterborne chromate (Cr6+) on protein abundance patterns in Lake trout (<i>Salvelinus namaycush</i>) Simmons, D.*, Sherry, J., Neheli, T., Miller, J., Poirier, D., Watson-Leung, T., Chong Kit, R., Reiner, E., Simpson, M. | Sex and the undecided fish Cole, K.S.* | Using a 3-D hydrodynamic model to predict Grass Carp spawning success Heer, T.*; Wells, M.G., Mandrak, N.E. |
| 16:50-17:10 | Heavy rainfall and increased phosphorus concentrations drive | Sedimentomics: A systematic biomarker discovery method with | Extreme morphological divergence corresponds to heterogeneous | Space use in stream fishes Grant, J.W.A. | Examining the presence of the ideal free distribution across |

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| | early onset bloom in an Ontario reservoir Larsen, M.L.*; Venkiteswaran, J.J.; Baulch, H.M.; Simon, D.F. and Sauvé, S. | applications for paleolimnological reconstructions of Arctic treeline dynamics Bell, M.*; Saleem, S.; Korosi, J.; Kimpe, L.; Blais, J.M. | genomic divergence and deep-water adaptation of sympatric Arctic charr (<i>Salvelinus alpinus</i>) morphs in Gander Lake Newfoundland Kess, T.*; Dempson, B., Lehnert, S.J., Bentzen, P., Salisbury, S., Messmer, A., Duffy, S., Ruzzante, D., Nugent, C.M., Ferguson, M.M., Leong, J.S., Koop, B.F., Bradbury, I.R. | | regulatory boundaries in a groundfish fishery Enright, D.T.*; Gillis, D.M. |
| 17:10-18:10 | Executive Meeting SCL (Salon D) | | | | |
| 18:00-20:00 | Poster reception (2 nd floor foyer, appetizers provided) | | | | |
| 20:00-23:00 | Student social (Jack's, 2 nd floor, 539 Richmond St, appetizers provided) | | | | |

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| Saturday, Jan 5, 2019 | | | | | |
| 8:00-8:30 | Registration (2 nd floor foyer) | | | | |
| | <i>Rivers and Streams: Multi-scale Understanding and Tools</i> (Salon E) | <i>Impacts of Climate Change in Aquatic Ecosystems</i> (Salon F) | <i>Genomics and eDNA Applications in Fisheries and the Conservation of Aquatic Ecosystems</i> (Salon G) | <i>Miles Keenleyside Symposium</i> (Salon H) | <i>Movement Ecology</i> (Salon J) |
| 8:30-8:50 | An aquatic ecosystem classification for Ontario's rivers and streams Jones, N.E., and Schmidt B.J. | Permafrost thaw slumping structures zooplankton community composition in western Canadian Arctic lakes Auger, B.*; Victor, J., Thienpont, J.R., Kokelj, S.V., and Korosi, J.B. | Quantitative eDNA assessment of reintroduced Atlantic salmon (<i>Salmo salar</i>) in Lake Ontario tributaries using microsatellite markers | Landscape factors influencing stream temperature and brook trout distribution in Boreal streams Mackereth, R.W.*; Smith, A. | Assessing the fate of returning upper Yukon River Chinook Salmon (<i>Oncorhynchus tshawytscha</i>) Lapointe, N.W.R.*; Twardek, W.M.; Cooke, S.J. |

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| | | | Lulat, N.*; Wilson, C.C; Heath, D.D | | |
| 8:50-9:10 | Identifying seasonal road salt hotspots in three urban and urbanizing stream networks Melles, S.J.*; Oswald, C.; Ash, C. | Elucidation of synergistic impacts of climate changes and regional anthropogenic disturbance on arctic great lake ecosystems Zhu, X. | Comparison of non-native freshwater fish detection efficiencies and costs using conventional and eDNA approaches to inform conservation management decisions on the deployment of monitoring resources Davison, P.I., Créach, V., Vilizzi, L., Britton, J.R., Copp, G.H.* | Drivers of temporal life history variation in Lake Erie's harvested yellow perch (i) Gislason, D*; McLaughlin, RM*; Robinson, BW* | Experimentally testing habitat selection by phenotype matching in a natural pumpkinseed sunfish (<i>Lepomis gibbosus</i>) population deLeeuw, A.D.*; Robinson, B.W |
| 9:10-9:30 | Lake outlet effects on stream segments and watersheds Allerton, M.*; Jones, N.E.; Melles, S.J.; Schmidt, B.J. | Historical changes in thermal regime and its influence on abundance and community structure of Kawartha Lakes piscivore communities Fox, M.G.* | Genetic tracking of an invasion: Round goby in the Great Lakes Heath, D.D*; Wellband, K.; Balasingham, K.; Ens, J; Johansson, M. | Drivers of temporal life history variation in Lake Erie's harvested yellow perch (ii) Gislason, D*; McLaughlin, RM*; Robinson, BW* | Individual differences in behaviours do not influence trapping efficiency of invasive Sea Lamprey (<i>Petromyzon marinus</i>) in the St. Marys River Holub, R.R.* and McLaughlin, R.L. |
| 9:30-9:50 | Spatial patterns of stable isotope ratios of C and N in Great Lake tributaries: The influence of resource subsidies and fragmentation McKenzie, M.*; Jones, N.E. | The cellular stress response to an acute heat shock in larval sea lamprey with potential ecological consequences in a warming world Sutherby, J.S.*; Birceanu, O.; Wilkie, M.P.; and Jeffries, K.M. | Meta-analysis supports further refinement of eDNA for monitoring aquatic species-specific abundance in nature Yates, M.C.*; Fraser, D.J.; Derry, A.M. | The essential role of fish behaviour in the detection process of monitoring programs Ridgway, M.S.*; Middel, T., and Bell, A. | Fall migration patterns and habitat use of anadromous Arctic char (<i>Salvelinus alpinus</i>) near Kugluktuk, Nunavut Smith, R.*; Swanson, H.; Loewen, T.; Dumond, A.; Kristensen, K. |
| 9:50-10:10 | Can measures of fish community size structure be used as indicators in | Considering the cumulative effects of environmental, biological | Metabarcoding of native and invasive prey in stomach content DNA | | Turbine entrainment vulnerability of bull trout and lake trout in |

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| | stream monitoring programs? Sutton, I.*; Jones, N.E. | and anthropogenic stressors on walleye productivity Jarvis, L.*; Chu, C.; McMeans, B. | (scDNA) of commercially harvested Lake Erie fishes Mychek-Londer J.G.*; Venney C. J., and Heath, D. D. | | Williston Reservoir, BC Harrison, P.M.*; Ward, T., Algera, D.A., Leake, A.J., Cooke, S.J., & Power, M. |
| 10:10-10:30 | Can the metabolic theory improve productivity estimates of stream fish communities? Richter, I*.; Jackson, Don; Jones, Nick | Recreational angler perceptions in a changing word: implications for recreational fisheries management and policy development Jeanson, A. L.*; Cooke, S. J., Young, N. | Mapping the plume of Environmental DNA from a Chinook salmon farm in a well-mixed saltwater ecosystem Kajtar, A.*; Devlin, R.; Heath, J.W.; Heath, D.D. | | Brook trout (<i>Salvelinus fontinalis</i>) habitat use and movement in urban streams Blair, S.G.*; Gutowsky, L.F.G. and M.G. Fox |
| 10:30-11:00 | Nutrition break (2 nd floor foyer) | | | | |
| | <i>Limnology at the Landscape Level: Integrating Multiple Stressors and Scales</i> (Salon E) | <i>Impacts of Climate Change in Aquatic Ecosystems</i> (Salon F) | <i>Genomics and eDNA Applications in Fisheries and the Conservation of Aquatic Ecosystems</i> (Salon G) | <i>Niche Biology</i> (Salon H) | <i>Conservation & Management</i> (Salon J) |
| 11:00-11:20 | Reconstructing cultural eutrophication in lake sediments using sterols Gallant, L.R.*; Kimpe, L.E.; Eickmeyer, D.C.; Blais, J.M. | Guiding principles for preventing cyanobacteria blooms in a changing climate: Integrating nutrient limitation and sediment redox science into watershed management Molot, L.A.*; S.L. Schiff, J.J. Venkiteswaran, H.M. Baulch, S.N. Higgins, A. Zastepa, M.J. Verschoor, D. Walters | Genetic effects and plastic responses on brain morphology of brook charr (<i>Salvelinus fontinalis</i>) differing in foraging style Cantera, K.C.*; McLaughlin, R.L. | From top to bottom: Do Lake Trout diversify along a depth gradient in Great Bear Lake, NT, Canada? Chavarie, L*.; Howland, K.L.; Harris, L. N.; Hansen, M.J.; Harford, W.J.; Gallagher, C.P.; Baillie, S.M.; Malley, B.; Tonn, W.M.; Muir, A.M.; Krueger, C.C. | Using citizen science to solve fisheries data gaps in Canada and provide managers with a new monitoring tool Simmons, Sean |

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| 11:20-11:40 | Impact of increased thermokarst activity on Polycyclic Aromatic Compound (PAC) accumulation in sediment of lakes in the hydrocarbon-rich uplands adjacent to the Mackenzie Delta, NT, Canada Eickmeyer, D.C.*; Thienpont, J.R., Blais, J.M. | Parsing out the influence of climate: What is driving recent cyanobacterial growth in the St. Lawrence River? Moir, K.E.*; Cumming, B.F. | Heterogeneous genomic divergence between European and North American Atlantic salmon (<i>Salmo salar</i>) highlights small and large genomic drivers of trans-Atlantic isolation Lehnert, S.J.*; Kess, T.; Bentzen, P; Kent, M.P.; Lien, S.; Clément, M.; Bradbury, I.R | Diet and isotopic niche of Eastern Sand Darter (<i>Ammocrypta pellucida</i>) at the northern edge of its range: a test of niche specificity Burbank, J.*; Finch, M.; Drake, D.A.R. & Power, M. | Co-production as a viable model for freshwater research in Canada Kirkwood, A.E.* |
| 11:40-12:00 | Multiscale drivers of phytoplankton communities and their species' traits Loewen, C.J.G.*; Vinebrooke, R.D.; Zurawell, R.W. | Testing for warming-induced shifts in body size for cold-water fish Warne, C.P.K.*; Rooney, N., McCann, K.S. | Applying transcriptomics to the interactive effects of thermal and pre-natal stress on developmental plasticity in juvenile chinook salmon Finerty, C.J*. Heath, D.D., Warriner, T.R., Semeniuk C.A.D., Love, O.P. | Pop-off data storage tags reveal niche partitioning among predators in Lake Ontario Raby, G.D.*, Johnson, T.B., Fisk, A.T. | Benthic invertebrate flow sensitivity as a tool to detect biologically meaningful flow alteration in a regulated river in northern Ontario Timusk, E.R.*, Smokorowski, K.E., Armanini, D.G. |
| 12:00-13:20 | Lunch (on your own) | | | | |
| | Limnology at the Landscape Level: Integrating Multiple Stressors and Scales (Salon E) | Anthropogenic Stressors (Salon F) | Applying Physiology to Conservation and Fisheries Management (Salon G) | Niche Biology (Salon H) | Community Ecology (Salon J) |
| 13:20-13:40 | Isoscapes and limnoscaples of the Peace-Athabasca Delta: A foundation for hydrolimnological monitoring Remmer, C.R*; Neary,L.K; | Is the Red Deer River a mercury bioaccumulation hotspot? A comparison of mercury levels in fish from various rivers in Alberta | Immediate behavioral and physiological response from catch-and-release of wild white sturgeon (<i>Acipenser transmontanus</i>) McLean, M.F.*; Litvak, | Rainbow trout (<i>Oncorhynchus mykiss</i>) habitat overlap with wild Atlantic salmon (<i>Salmo salar</i>) and brook charr (<i>Salvelinus fontinalis</i>) in natural streams: Do | Characterizing species co-occurrence patterns of imperfectly detected stream fishes: informing repatriation of the imperiled Eastern Sand Darter |

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|-------------|--|---|---|--|---|
| | Owca, T; Wolfe B.B; Hall,R.I | Donadt, C.R.*; Graydon, J., Cooke, C., Poesch, M. | M.K.; Cooke, S.J.; Hanson, K.C.; Patterson, D.A.; Hinch, S.G.; Crossin, G.T. | habitat and landscape factors override competitive interactions? Roloson S.D.*; Knysh K.M.; Coffin M.R.S.; Gormley K.L.; Pater C.C.; van den Heuvel M.R. | Lamothe, K.A.*; Drake, D.A.R.; Dextrase, A.J. |
| 13:40-14:00 | Pan-Canadian picture of lakes contributions to the global GHGs emissions: preliminary results from the first Lake Pulse campaign in Eastern Canada Kim, Jihyeon*; Prairie, Yves | What are the consequences of downstream fish entrainment and impingement associated with hydroelectric dams? A systematic review Algera, D.A.*; Rytwinski, T.J., Taylor, J.J., Smokorowski, K.E., Bennett, J.R., Harrison, P.M., Bevelhimer, M., Clarke, K., Enders, E., Gibson, D., Janusz, R., Power, M., Cooke, S.J. | How energy content and temperature affect American shad swimming performance Bayse, S.M.*; McCormick, S.D.; Castro- Santos, T. | An evaluation of single- species and community- based approaches to assess impacts of habitat alteration on fishes and fish habitat Montgomery, F.*; Minns, K.; Reid, S.; Mandrak, N.E. | Partitioning fish communities into guilds for ecological analyses: an overview of current approaches and future directions Benoit, D.M., Jackson, D.A, and Chu, C. |
| 14:00-14:20 | Are the Great Lakes TOO great for using chironomids to reconstruct past changes in deepwater hypolimnetic oxygen? A cautionary tale from Lake Erie Quinlan, R.*; Perlov, D.A.; Reavie, E.D. | Fish community interactions with very low head hydroelectric turbine technology Tuononen, E.I.*, Smokorowski, K.E., Timusk, E.R., S.J. Cooke | Comparing bioenergetic vs. correlative habitat suitability models for stream salmonids Naman, S.M.*, Rosenfeld, J.S., Neuswanger, J.R., Eaton, B.C., Enders, E | Lake Trout (<i>Salvelinus namaycush</i>) habitat trends in south-central Ontario lakes: Insights from ~40 years of end-of- summer hypolimnetic oxygen data Nelligan, C.*; Jeziorski, A.; Rühland, K.M.; Paterson, A.M.; Smol, J.P. | Hold the shrimp: does extirpation of <i>Mysis</i> alter fish communities? Rennie, M.D.*; Milling, A., Colvin, T. and Paterson, M.J. |
| 14:20-14:40 | Long-term effects of wildfire in boreal headwater catchments on riparian-stream | Characterizing IISD-ELA lakes to predict safe drinking water sources with minimal disinfection | The effects of total dissolved gas on fish physiology and survival | Experimental vertebrate translocations reveal the relative importance of habitat and population | The use of stable isotopes for examining the base of the food web in Canadian Shield lakes |

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| | linkages: implications for forest management Musetta-Lambert, J.L.*; Muto, E.A.; Kreutzweiser, D.P.; Sibley, P.K. | by-products Atkins, J.H.L.*; Venkiteswaran, J.J.; Schiff, S.L.; Higgins, S.N.; Emilson, E.J.S. | Pleizier, N.K.*; Algera, D., Cooke, S.J., Brauner, C.J. | genetic risks in novel environments Yates, M.C.*; Bowles, E.; Fraser, D.J. | Barber, E.J.*; Schiff, S.L.; Venkiteswaran, J.J.; Elgood, R.J.; Salk, K.R.; Higgins, S.N |
| 14:40-15:00 | Examining the long-term algal responses to metal contamination within the context of multiple environmental stressors: case studies of lakes around Yellowknife, NT 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. | Water quality effects on <i>Odonata</i> nymphs in urban ponds Perron, M.C.*; Pick, F.R. | Differences in quality between hatchery-reared and wild-origin bloater (<i>Coregonus hoyi</i>) eggs Lajoie, C, T. Drew, K. Loftus, M. Arts, R. Wehse, T. Pitcher* | Habitat characteristics and fish community in small, seasonal arctic streams in the Kivalliq Region, Nunavut Portt, C.B*, Coker, G., Reid, J., Vanengen, R., Ellenor, J. | Changes to the zooplankton community in response to the removal of <i>Mysis diluviana</i> from an Ontario lake Milling, A.*; Rennie, M.D., Paterson, M.J. |
| 15:00-15:30 | Nutrition break (2 nd floor foyer) | | | | |
| | Ecosystem Ecology (Salon E) | Anthropogenic Stressors (Salon F) | Applying Physiology to Conservation and Fisheries Management (Salon G) | Niche Biology / Life History & Demography (Salon H) | Community Ecology (Salon J) |
| 15:30-15:50 | Seasonal patterns of phosphorus movement from terrestrial to aquatic systems in an agriculturally-impacted landscape Bauman, J.*; Rooney, N. | Unraveling the direct and indirect effects of climate and land-use on fish mercury levels using Structural Equation Models Thomas, S.M.*; Melles, S.J., Bhavasar, S.B. | Effects of thermal stress and hypoxia on the endangered Pugnose Shiner Potts, L.B.*; Chapman, L.J.; Mandrak, N.E. | Habitat associations of fishes in the Kivalliq region of Nunavut, Canada Hancock, H.*; Kanavillil, N., Rennie, M., Doka, S. | Island biogeography of macroinvertebrates in large marine ecosystems Stortini, C.H.* |

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|-------------|---|--|--|---|---|
| 15:50-16:10 | Determining major influences on carbon balance of shallow northern floodplain lakes (Peace-Athabasca Delta, Alberta) Neary, L. K.*; Remmer, C.R.; Klemm, W.K.; Kay, M.L.; Wolfe, B.B.; Hall, R.I. | Individual- and population-level effects of a whole-ecosystem nanosilver addition on Yellow Perch (<i>Perca flavescens</i>) at the IISD-Experimental Lakes Area Hayhurst, L.D.*; Metcalfe, C.D.; Rennie, M.D. | Thermal behaviour and metabolic performance of the Westslope Cutthroat Trout (<i>Oncorhynchus clarkii lewisi</i>) across temperatures Macnaughton, C.J.*; Durhack, T.D.; Charles, C.; Kovachik, C.; Mochnacz, N.; Enders E.C. | Intraspecific variation of density-dependent growth and mortality among three neighbouring populations of a stream fish Matte, J.-M.; Fraser, D.J.; Grant, J.W.A. | Drivers of fish occurrence in Arctic lakes Shuvo, A.*; Sharma, S.; Gray, D. |
| 16:10-16:30 | Estimating historical changes in cyanobacterial production from lake sediments using Visible Near-infrared Reflectance Spectroscopy (VNIRS) Favot, E.J.*; Hadley, K.R.; Michelutti, N.; Paterson, A.M.; Smol, J.P. | Cumulative land use effects on boreal fish communities in a changing climate Murdoch, A.*; Sharma, S. | Gill filament calcification: a mechanism to enhance fish respiratory function? Turko, A.J.*; Wright, P.A. | Size selectivity of traditional and knotless diamond codends in the Iceland redfish (<i>Sebastes</i> spp.) fishery Z. Cheng*, H. A. Einarsson, S. Bayse, B. Herrmann, P. Winger | The use of non-traditional oxygen stable isotopes in delineating trophic ecology and mercury bioaccumulation in freshwater fish Lescord, G.L.*; T.A. Johnston, A. L. James, B. A. Branfireun, J. M. Gunn |
| 16:30-16:50 | Connecting the emergence of algal blooms in Lake Scugog to a possible invasional meltdown scenario Harrow-Lyle, T*. and Kirkwood, A.E. | | Interactions among metabolism, growth, and behaviour in fish exposed to thermal variability Guzzo, M*; van Leeuwen, T; Norin, T; Metcalfe, N; McCann, K; Killen, S | Ecological change alters the evolutionary response to harvest in a freshwater fish Gobin, J.*; Lester, N.P., Fox, M.G., Dunlop, E.S. | Are we fishing down the food web in Lake Simcoe? Dunlop, E.S.*; Goto, D., Jackson, D. |
| 16:50-17:10 | | Ecology and food quality of riverine fish populations of the Hudson Plains Ecozone, northern Ontario Johnston, T.A.*; | Assessing the physiological status of walleye (<i>Sander vitreus</i>) across two contexts in Manitoba Jeffrey, J.D.*; Gaudry, | Providence revisited: The overlooked role of provenance in shaping life histories of brown trout (<i>Salmo trutta</i>) Elvidge, C.K.*; | |

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|-------------|---|---|---|---|--|
| | | Heerschap, M.J.; Keller, W.; Gunn, J.M. | M.J., Enders, E.C., Jeffries, K.M., Treberg, J.R. | Lemopoulos, A.; Hyvärinen, P.; Vornanen, M.; Vainikka, A. | |
| 17:10-18:10 | CCFFR/SCL conference executive meeting (Salon D) | | | | |
| 17:10-18:00 | Cash Bar (Ballroom 2-3) | | | | |
| 18:00-20:30 | Banquet (Ballroom 2-3) | | | | |

| Sunday, Jan 6, 2019 | | | | | |
|---------------------|---|--|---|--|---|
| | <i>Ecosystem Ecology</i> (Salon E) | <i>Understanding and Mitigating Impacts of Unconventional Oil Production and Transport on Canada's Aquatic Resources</i> (Salon F) | <i>Applying Physiology to Conservation and Fisheries Management</i> (Salon G) | <i>Reproductive Strategies</i> (Salon H) | <i>Conservation & Management</i> (Salon J) |
| 8:30-8:50 | Iron isotopes reveal novel metabolic pathways for iron cycling in boreal shield lakes Liu, K.*; Schiff, S.L.; Wu, L.; Molot, L.A.; Venkiteswaran, J.; Paterson, M.; Elgood, R.; Tsuji, J.M.; Neufeld, J.D. | | Investigating non-physical barriers and the role of inter-individual fish variation Bzonek P.B.*; Edwards, P.D.; Hasler, C.T.; Suski, C.D.; Boonstra, R.; Mandrak, N. E. | Sexual selection and the evolution of sexual size dimorphism in lake whitefish Morbey, Y.E. | Conservation and recovery efforts for Westslope Cutthroat Trout using Rotenone Stitt, B.C.*; Goudie, M.T.; Humphries, S. |

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| 8:50-9:10 | Setting nutrient thresholds to protect stream water quality and ecological condition Thomas, K. *, Chambers, P., Yates, A. | Assessing the effects of TiO ₂ -treated oil sands wastewater exposure on developing fathead minnows (<i>Pimephales promelas</i>) Madison, B.N.; Halliwell, L.; Reynolds, J.; Leshuk, T.; Gu, F.; Peru, K.M.; Headley, J.V.; Orihel, D.M. | An appetite for invasion: the energetics of feeding & digestion in invasive lionfish Steell, S.C. *; Van Leeuwen, T.E.; Brownscombe, J.W.; Cooke, S.J.; Eliason, E.J. | Reproductive status of walleye (<i>Sander vitreus</i>) and lake whitefish (<i>Coregonus clupeaformis</i>) in two large, shallow subarctic lakes Dixon, H. J. *, Harrison, G., Lister, A., and MacLatchy, D. | Role of acoustics in freshwater fisheries management: Applications in the Alberta oil sands Terry, M.W. *; Poesch, M. |
| 9:10-9:30 | Diel trends in stable isotope values of dissolved inorganic carbon in a eutrophic boreal lake Henderson, R.I. *; Salk, K.R.; Schiff, S.L.; Venkiteswaran, J.J. | The BOREAL Project: Overview of an experimental oil spill to limnocorrals at the IISD Experimental Lakes Area Blais, J.M. *; Orihel, D.M.; Rodriguez-Gil, J.L.; Hollebhone, B.; Palace, V.; Hanson, M. | Predicting the interactions of native and invasive stream fishes to multiple stressors Kindree, M.M. *, Jones, N.E., Mandrak, N.E. | Patterns of reproductive success among reintroduced Atlantic salmon in two Lake Champlain tributaries Prevost, A.D. *, Hill, N.L, Grant, J.W.A, Ardren, W.A, Fraser, D.J. | Technical, strategic, and policy considerations around setting Recovery Targets (Population and Distribution Objectives) for species at risk Rosenfeld, J. S. * |
| 9:30-9:50 | The role of Fe in the photodegradation of dissolved organic carbon in boreal lakes Mead, J.L. *; Venkiteswaran, J.J.; Elgood, R.J.; Schiff, S.L. | Diluted bitumen spills and the boreal freshwater ecosystem: a microcosm study Cederwall, J *; Black, T; Blais, J.M.; Hanson, M.L.; Hollebhone, B.; Palace, V.P.; Rodríguez-Gil, J.L.; Greer, C.W.; Maynard, C.; Ortmann, A.C.; Rooney, R.C.; Stoyanovich, S.; Orihel, D.M | Integrating molecular and metabolic indices with walleye movement patterns in Lake Winnipeg Jeffries, K.M. *, Thorstensen, M.J., Jeffrey, J.D., Watkinson, D.A., Enders, E.C., Treberg, J.R. | The effects of senescence and female body condition on potamodromous Chinook salmon egg quality Lajoie, C.M.E. *; Warriner, T.R.; Pitcher, T.E; Semeniuk, A.D.; Love, O.P. | Have your fire hose and drink from it, too: an expert-approved approach to using angler apps to generate large volumes of usable data Venturelli, P.V. * |
| 9:50-10:10 | Phytoplankton fractionation of iron Shah, P. *; | Behavioural responses to diluted bitumen in wood frog tadpoles Hasler, C.T. *; Denton, D.; | Effects of dual stressors on energetics and performance of African | Behavioural phenotypes of sneaker male Chinook salmon in fresh and saltwater | Effects of vessel and trawl noise on acoustic fish density estimates |

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|-------------|--|---|---|--|---|
| | Venkiteswaran, J., Molot, L. | Patterson, S.A.; Blais, J.M.; Palace, V.; Hanson, M.; Hollebhone, B.P.; Rodriguez-Gil, J.L.; Orihel, D.M. | equatorial fishes Chapman, L.J. | Church, K.*, Janisse, K., Forest, A., Heath, J., Heath, D., Semeniuk, C. | Trumpickas, J. *, Dunlop, E.S. |
| 10:10-10:30 | Iron and molybdenum influence growth and microcystin production of a freshwater cyanobacterium, <i>Microcystis aeruginosa</i> Creed, I.F.; Enanga, E.M.*; Erratt, K.J.; Xu, Y.; Trick, C.G. | Freshwater Oil Spill Remediation Study (FOReSt): Examining natural attenuation of oiled shorelines and effects of residual oil on biota at IISD-ELA Hrenchuk, L.E.*; Bulloch, P.; Dearnley, J.; Dettman, H.; Greer, C.; Hanson, M.; Higgins, S.; Paterson, M.; Peters, L.; Shanoff, T.; Taylor, E.; Timlick, L.; Tomy, G.; Wiseman, G.; Palace, V. | Coldwater species in a warming world: challenges for sustainable management Wilson, C.C.*; Burness, G. | Old funks don't always have junk spunk: a clear lack of reproductive senescence in sperm quality within the long-lived indeterminate growing lake trout Purchase*, C.F., Rennie, M.D., Rooke, A.C., Treberg, J.R. | You shall not pass! The effectiveness of a passive size-based method for selective fish passage Smith, M.R.*; McLaughlin, R.L. |
| 10:30-11:00 | Nutrition break (2 nd floor foyer) | | | | |
| | <i>Ecosystem Ecology</i> (Salon E) | <i>Paleolimnology</i> (Salon F) | | <i>Life History & Demography</i> (Salon H) | |
| 11:00-11:20 | Constant nutrient loads yield a lake with changing cyanobacteria blooms Larsen, M.L.; Venkiteswaran, J.J.*; Baulch, H.M.; Schiff, S.L.; Higgins, S.N. | Assessing Historical Data and spatial variation in Cladoceran species assemblages in Lake Scugog Jeyarajah, J.*; Thienpont, J., Harrow-Lyle, T., Kirkwood, A., & Korosi, J. | | Density-dependent growth of brook trout in pristine and over-harvested systems Glaser, D.M.*; Post, J.R. | |

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| 11:20-11:40 | Legacy selenium deposition continues to inhibit mercury accumulation in freshwater organisms in Sudbury, Ontario Azdajic, M.*; Belzile, N.; Gunn, J.M.; Poulain, A.J.; Blais, J.M. | Paleolimnological data from the Canadian LakePulse Network 2017 field campaign (Eastern Canada) Jeziorski A.*, Griffiths K., Simmatis B., Gregory-Eaves I., Antoniadis D., Smol J.P. | | Is there evidence of density dependent somatic growth in Alberta's walleye lakes? Cahill, C.L*, Paul, A.J, and J.R. Post | |
| 11:40-12:00 | Old tools applied at new scales to monitor the frequency and magnitude of algal blooms Dallosch, M.A.*; Creed, I.F. | Holocene water balance variability and change in Northeastern Ontario, Canada reconstructed from lake sediment carbonate stable isotopes and XRF data Boreux, M.P*.; Lamoureux, S.F.; and Cumming B.F. | | | |

Invited Plenaries



Dr. Sean Anderson
Pacific Biological Station

J.C. Stevenson Memorial Lecture: “Incorporating black-swan events into fisheries science”

Sean Anderson is a biologist at the Pacific Biological Station with Fisheries and Oceans Canada in Nanaimo, British Columbia. He was a Smith Fellow postdoctoral researcher at the University of Washington until 2017, received his Ph.D. in 2015 from Simon Fraser University, and his M.Sc. from Dalhousie University. Sean links theory with data through statistical and simulation models to improve predictions about ecological systems and inform management and policy decisions. His research broadly spans the field of quantitative ecology. In particular, he is interested in ecological extremes in time or space (e.g. black-swan events), ensemble and data-limited approaches in fisheries stock assessment, the effects of climate change on fish population distribution, and ecological portfolio effects such as the benefits and risks of diversification for fishers and fish populations.



Dr. Marie Eve Monchamp
Swiss Federal Institute of Aquatic Science and Technology

Robert Peters Award Recipient

Marie-Eve Monchamp received her Ph.D. in 2017 from the Swiss Federal Institute of Aquatic Science and Technology and the Swiss Federal Institute of Technology Zurich. She completed her Master’s in Aquatic sciences at Université de Montréal in 2013 and her undergraduate studies in environmental sciences at Université du Québec à Montréal. Marie-Eve’s current research focuses on using DNA-based methods in paleolimnology to investigate long-term changes in the structure and biodiversity of planktonic communities impacted by human activities. This award is in recognition for the following paper: *Monchamp, M.E., Spaak, P. Domaizon, I., Dubois, N. Bouffard, D and Pomati, F. 2018. Homogenization of lake cyanobacterial communities over a century of climate change and eutrophication. Nature Ecology and Evolution 2: 317-324.*



Dr. Bernadette Pinel-Alloul

Université de Montréal

Frank Rigler Memorial Award Lecture

Bernadette Pinel-Alloul is an ecological scientist at the Department of Biological Sciences at the University of Montréal. She is member of the Interuniversity Research Group in Limnology and Québec Centre for Biodiversity Science. Her research aims to evaluate the importance of zooplankton in controlling ecosystem dynamics in freshwaters.

Dr. Bernadette Pinel-Alloul and her team of students and collaborators have investigated since the seventies how multi-scale and multi-system environments control the structure and function of zooplankton communities in freshwater ecosystems. Using zooplankton as a model research, Pinel-Alloul explored how trophic states, anthropogenic disturbances, climate gradients in Canadian ecozones affect the abundance, assemblages and richness of freshwater zooplankton, and analysed emerging patterns and processes of community structure and diversity at a variety of scales in lakes, rivers and ponds. Her research offers a multi-faceted and a multi-scale way to examine zooplankton community structure combining the lens of taxonomic, functional and genetic approaches.

Panel Discussion : Tips to get a job in Aquatic Sciences

The panel discussion will provide opportunities for current students and/or recent graduates to engage in discussions with early career scientists and professionals who have recently made the transition from academia to work place or professionals who are involved in, or are familiar with, the hiring process of their institution/organization. Students will benefit by discovering which skills and qualifications are important to highlight on their CV and learning tips for interview preparation. For new students, they will benefit from understanding which skills they may need to develop throughout their studies, and which qualifications are sought after by employers.

Students will be invited to ask questions or submit their questions via social media during the session. Students may also submit questions prior to the event to facilitate the beginning of the discussion and help to focus the discussion around the students' interest.

Panelists

Dr. Nicholas Jones (Ph. D.)

Research Scientist – Ontario Ministry of Natural Resources and Forestry (OMNRF)

Nick has led research in the River and Stream Ecology Lab for the last 15 years. His research is eclectic, covering subjects such as resource studies in tributaries of the Great Lakes to stream ecoclassification in Ontario.

Nick has participated to the hiring process of numerous research and technical staff. Through his experience at the OMNRF, Nick will share his insights and advice to identify strategies to best prepare a transition from academia to the public sector.

Dr. Brian Cumming (Ph. D.)

Professor and Head of the Biology Dept. – Queen's University

Brian's research focuses on the use of paleolimnological techniques to study how ecological and environmental change occurs in lakes over decades to millennia, from both natural (e.g., climate) and human-based stressors (e.g. acidic deposition), and is the co-director of the Paleoecological Environmental Assessment and Research Lab.

Brian has experience in hiring at least seven faculty as part of his role as the Director of the School of Environmental Studies, and more recently as the Head of Biology, and can give some advice on how to prepare for a career in academia.

Dr. Jennifer Korosi (Ph. D.)

Assistant Professor, Department of Geography – York University

Jenny's current research focuses on ecological and biogeochemical change of aquatic ecosystems, encompassing a broad range of ecosystem types across Canada.

As a new faculty addition to the Department of Geography at York University, Jenny can give insight into her successes and speak to the challenges of finding employment in academia and beginning her research program. Jenny can also discuss her involvement in the hiring of new faculty at York.

Mr. Anthony Merante (M.Sc.)

Specialist, Freshwater Program – WWF-Canada

Anthony is a trained ecologist, with strong emphasis and experience in aquatic ecosystems (marine and freshwater) as well as their interaction with the terrestrial ecosystem.

From a master of science at l'Université du Québec à Montréal to specialist in the Freshwater Conservation program of WWF-Canada, Anthony knows a lot about the cross sectoral reality of working beyond academia using a science degree.

Dr. Neil Hutchinson (Ph.D.)

President and Principal Scientist – Hutchinson Environmental Sciences Ltd.

Neil has 40 years of experience as an aquatic scientist in both the public and private sector and, for the past 9 years, as the president and principal scientist at Hutchinson Environmental Sciences Ltd. He has applied his knowledge to research, monitoring, policy development, environmental assessment, and peer review projects across Canada and is recognized as a national expert in water quality.

Neil's extensive and varied experience in the aquatic sciences makes him an ideal addition to this panel.

Dr. Yolanda Morbey (Ph.D.)

Associate Professor, Biology Dept. – Western University

Yolanda's research integrates evolutionary theory and empirical studies to investigate the adaptive timing behaviour of migratory fish,

Yolanda has experience in both government and academia, as a Research Scientist with the Ontario Government and an Associate Professor in Biology at Western University. Yolanda has long advocated for gender equity in science. Yolanda's insights into self-advocacy as a woman in science will be a valuable addition to our panel.

Dr. Nicholas Mandrak (Ph.D.)

Associate Professor – Dept. of Biological Sciences, University of Toronto Scarborough

Associate Professor and Director of a professional Master's program in Conservation and Biodiversity at the University of Toronto Scarborough, Nick is also the co-chair of the Freshwater Fishes Species Subcommittee of COSEWIC and President of the AFS Canadian Aquatic Resources Section. Prior to joining academia, Nick worked as a Research Scientist and Executive Director at Fisheries and Oceans Canada, where he developed and implemented an endangered species program, and a national Centre of Expertise for Aquatic Risk Assessment of aquatic invasive species.

Nick can discuss his experience in academia and public sector, comparing research vs. professional graduate programs, and the importance of professional engagement.

Symposia

Miles Keenleyside Symposium

Session organizer: David L. G. Noakes

In this Special Session we review and summarize the contributions that Miles has made to fisheries research in Canada during his career. Miles began as a protégé of Bill Hoar at the University of British Columbia. He was one of the first to study in the emerging field of ethology in Europe. His doctoral thesis on the schooling behaviour of fishes brought remarkable clarity and rigorous experimental testing of hypotheses that were enduring characteristics throughout his career. He brought that experience, and scientific approach to the study of behaviour, ecology and fisheries management in Canada. With Fisheries and Oceans in New Brunswick he pioneered underwater observations of fish behaviour, including the disruptive effects of pesticides on behaviour and conservation. His faculty career at the University of Western Ontario focused on Centrarchids and Cichlids, but with detailed studies on species as diverse as sticklebacks, mudminnows, darters and coral reef fishes. His landmark volumes on diversity of behaviour in fishes, and the behaviour of cichlid fishes remain as current as ever as the standards for scientific quality. It is a personal pleasure and privilege to bring this Special Session to Miles at his home institution in his home city.

Showcase of Early Career Women in Aquatic Ecology & Conservation Research.

Session organizer: Yolanda E. Morbey

This symposium will showcase the research programs of early- to mid-career women engaged in aquatic ecology and conservation research in Canada. Too often, women face barriers in transitioning from higher education into tenured research positions at universities. We are encouraged to pursue careers we like and choose – but not to be too ambitious or successful. The contributors in this session represent some of those who didn't "leak out of the pipeline" and have continued to make significant contributions to aquatic ecology, conservation, and fisheries research.

Understanding and Mitigating Impacts of Unconventional Oil Production and Transport on Canada's Aquatic Resources.

Session organizers: Diane Orihel & Jules Blais

Canada's oil sands constitute the third largest known oil reserve in the world: covering an area of 142,200 km², these deposits contain an estimated 168 billion barrels of crude oil. The rapid expansion of oil sands development in northern Alberta over the last few decades has been one of the most publicized environmental issues in Canada. Government policies and regulations have struggled to keep pace with development, creating serious challenges in managing the

environmental, social and economic impacts of this industry. In particular, serious concerns have grown over the potential adverse impacts of oil sands development on water quality and quantity. Furthermore, the transport of oil sands products, particularly diluted bitumen, by train or pipeline poses risks to aquatic ecosystems due to potential spills. In this special session, we invite presentations that will advance our understanding of the impacts of unconventional oil production and transport on freshwater ecosystems, as well as presentations that will discuss mitigation strategies to reduce these impacts.

Rivers and Streams: Multi-scale Understanding and Tools.

Session organizers: Nick Jones & Stephanie Melles

Watersheds are composed of hierarchically nested branched directional networks that present challenges in studying their function at different spatial scales. This symposium will focus on understanding streams across scales and providing tools for research and management. Presentation will focus on broad-scale classification of flowing waters, network analyses of road salt in urban streams, the integration of lakes into stream networks, spatial patterns of resource subsidies in Great Lakes tributaries, and if size spectra analyses are useful for multiscale stream monitoring programs

Applying Physiology to Conservation and Fisheries Management.

Session organizers: Christine L. Madliger, Graham D. Raby, Steven J. Cooke

The management of fisheries can benefit from a mechanistic understanding of the effects of stressors on individual fishes, populations, and ecosystem functioning. The field of conservation physiology involves a diverse set of tools that can link individual performance to population dynamics, provide information on sex and reproductive status, offer insight into adaptive potential, and assess and compare stocking and restoration strategies. This session will showcase how research using a variety of physiological techniques and traits (e.g., respiratory physiology, transcriptomics, genetics, stress physiology) can help determine vulnerability to stressors, local adaptation, drivers of fish distribution and abundance, and how to better contain invasive species. Most importantly, we will explore how investigating the mechanisms underlying behaviour, performance, and fitness through the collection of physiological data could help policymakers ensure fish and fish habitat are managed sustainably.

Impacts of Climate Change in Aquatic Ecosystems

Session organizers: Brian F. Cumming & Cécilia Barouillet

Regional climate change is an important stressor on most aquatic ecosystems, influencing their physical, chemical, and biological characteristics. Studying the effect of climate change on aquatic ecosystems is particularly important for the implementation of successful mitigation and adaptation strategies, and to better predict future ecological trajectories. However, in a multi-stressor era soon to become the Anthropocene, it is often difficult to disentangle the effect of climate change from other anthropogenic stressors, as well as identify the mechanisms responsible for climate-induced changes in aquatic systems. In this session, we invite presenters to share the innovative techniques and study design they use to disentangle climate impacts from localized stressors on aquatic ecosystems. Moreover, presentations will highlight the value of long-term observations at local, regional, and global scales.

Limnology at the landscape level: Integrating Multiple Stressors and Scales

Session organizers: Jérôme Marty & Mohamed Mohamed

Aquatic ecosystems are recognized as hotspots for ecosystem processes supported by a remarkable diverse set of species. Depending on land use and characteristics of the watersheds, loadings from terrestrial sources as carbon, nutrients and contaminants have contributed or altered the structure and function of freshwater ecosystems. Presentations in this session will explore the linkages between terrestrial and aquatic environments influencing the functioning of freshwater ecosystems.

Genomics and eDNA applications in fisheries and the conservation of aquatic ecosystems.

Session organizers: Paul Bentzen, Ian Bradbury, Daniel Heath\

Poster presentations

| Anthropogenic Stressors | | |
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| 1 | Connors, K.*; Anderson, P., Hughes, C. | Monitoring of a remediated stream impacted by the 2014 Mount Polley Tailing Storage Facility breach |
| 2 | Dulal-Whiteway, C.D.W.*; Rooney, N.; Turetsky M. | Investigating the biogeochemistry and metabolism of agriculturally impacted streams in Southwestern Ontario |
| 3 | Hayhurst, L.D.*; Metcalfe, C.D; Rennie, M.D | Biomarker and bioenergetic effects of a whole-ecosystem nanosilver addition on Yellow Perch (<i>Perca flavescens</i>) at the IISD-Experimental Lakes Area |
| 4 | Thienpont, J.R.*; Eickmeyer, D.C., Korosi, J.B., Chin, K., Kimpe, L.E., Blais, J.M. | Assessing polycyclic aromatic hydrocarbons (PAHs) and metals in sediments and benthic invertebrates near the Canol Shale Play (Central Mackenzie Valley, Northwest Territories) |
| Applying Physiology to Conservation and Fisheries Management | | |
| 5 | Kanagasabesan, T.*; MacLatchy, D. | Exploring physiological mechanisms for 17alpha-ethinylestradiol exposure tolerance in mummichog (<i>Fundulus heteroclitus</i>) across ovarian development |
| 6 | Moslemi-Aqdam, M.*; Abdolmalaki, Sh.; Swanson, H.K. | Sex ratio of Northern Pike (<i>Esox lucius</i>) in Anzali Wetland, SW Caspian Sea |
| 7 | Turko, A.J.*; Nolan, C.B.; Pitcher, T.E. | Thermal tolerance across age, sex, and season in endangered redbreast dace <i>Clinostomus elongatus</i> |
| 8 | Wiens, L.M.*; Jeffrey, J.D.; Enders, E.C.; Jeffries, K.M.; Treberg, J.R. | Metabolic profiling of walleye (<i>Sander vitreus</i>) blood from the Lake Winnipeg basin suggests regional differences in nutritional status |
| Community Ecology | | |
| 9 | Bontje, J. E.*; Jackson, D. A.; Drake, A. R. | Species co-occurrence modelling: the influence of biotic factors on Lake Chubsucker (<i>Erimyzon sucetta</i>) at multiple scales |
| 10 | Dixon, H.J.*; Brekke, L., and Swanson, H.K. | Using Broad Scale Monitoring (BSM) methods to assess the fish community of a small sub-Arctic lake |
| 11 | Guernon, S.*; Swanson, H., and A.M. Derry | The role of dissolved organic carbon and zooplankton community composition on methyl mercury bioaccumulation in Western Arctic lakes |
| 12 | Pearce, N.J.T.*; Thomas, K.E.; Lavoie, I.; Chambers, P.A.; and Yates, A.G. | Additive effects of sewage effluent on instream biological communities of agricultural rivers |

| | | |
|--|--|---|
| 13 | Ricker-Held, A* | The contribution of invertebrates to the seasonal diets of walleye in Lake St. Joseph |
| 14 | Third, L.*; De Kerckhove, D.; Chu, C. | Quantifying uncertainty, error and time-discounting to inform compensation ratios for freshwater fish productivity within a new Metabolic Theory of Ecology model |
| Conservation and Management | | |
| 15 | Bassi, A., Love, O.P., Cooke, S.J., Madliger, C.L.* | The fish perspective of artificial light at night |
| 16 | Corchis-Scott, R.G*.;Pitcher, T.E. | Genetically informed conservation breeding and reintroduction of an imperiled freshwater fish: elucidation of population structure, paternity and survival in <i>Erimyzon sucetta</i> |
| 17 | D.W. Archibald*, R. Rangeley | Fishery Audit 2018: Unlocking Canada's potential for abundant oceans |
| 18 | Ellenor, J.*, Portt, C.B., Swanson, H.K. | Variation in Slimy Sculpin (<i>Cottus cognatus</i>) condition and growth rate in six Barrenland lakes in central Nunavut |
| 19 | Goudie, M.T.*; Stitt, B.C.; Humphries, S. | Rotenone: dusting off a useful management tool in the Mountain National Parks |
| 20 | Harper, D.L., Bethoney, N.D., Stokesbury, K.D.E., Lundy, M., Stokesbury, M.J.W., McLean, M.F.* | Video survey techniques for estimating sea cucumber (<i>Cucumaria frondosa</i>) population dynamics for improved resource management within fishing areas |
| 21 | Midwood, J.D., Boston, C. | Assessment of the precision a fish index of biotic integrity for evaluating ecosystem condition |
| 22 | Mokdad, A.I.*; Garner, S.R., Neff, B.D., Pitcher, T.E. | Effects of Hard and Soft Release on Post-Release Performance of Atlantic Salmon (<i>Salmo salar</i>) |
| 23 | Therrien, C.A.*; Morbey, Y.E., Neff, B.D. | Effects of stream habitat structure on foraging in Atlantic salmon (<i>Salmo salar</i>) |
| Ecosystem Ecology | | |
| 24 | Boreux, M.P.*; Roy, J.W.; Yates, A.G.; Robinson, C.E. | Assessment of groundwater-stream water interactions and stream nutrient status in agricultural landscapes in the Upper Thames River Watershed, Ontario, Canada |
| 25 | Dodsworth, W.P.*; Pick, F.R. | Temporal trends in cyanobacteria in Central Ontario lakes through paleo-DNA analyses |
| 26 | Kroeze, S.L*.; Boreux, M; Robinson, C.; Roy, J.W.; Yates, A.G. | The relationship between organic matter breakdown and groundwater fluxes in Kintore Creek |
| 27 | Ruppert, J.L.W.*; Lawrie, D.L., Taylor, N. | Cumulative thermal impacts of storm water pond outflows on instream aquatic ecosystems |
| Genomics and eDNA Applications in Fisheries and the Conservation of Aquatic Ecosystems | | |

| | | |
|--|---|--|
| 28 | Gallage, K. S. *, Mandrak, N. E., Lovejoy, N. R., Lujan, N. K. | Metagenomic approach to identify and quantify juvenile fish and eggs from the Great Lakes Basin |
| 29 | Grove, C.M. *, Roloson, S.D., Pavey, S.A., van den Heuvel, M.R. | Population genomics of Atlantic salmon (<i>Salmo salar</i>) and its implications on Prince Edward Island, Canada |
| 30 | Leger, J.* and Simmons, D.B.D. | Adaptive responses to hypoxic conditions in blood and plasma proteins sampled from <i>Oncorhynchus mykiss</i> in the laboratory |
| 31 | Thorstensen, M.*; Jeffries, K. | Plasticity, selection, and ions: How an estuarine fish is coping with increasing salinity |
| Genomics and eDNA Applications in Fisheries and the Conservation of Aquatic Ecosystems | | |
| 32 | Leclair, A.T*; Drake, D.A.R; Mandrak, N.E. | It's getting hot in here! Seasonal variation in critical thermal maxima of redbreasted dace (<i>Clinostomus elongatus</i>) |
| 33 | Schiff, S.L.*, Muir, D.C.G., Dainard, P. Aukes P.J.K., Elgood, R.J., St. Louis, V.L., St. Pierre, K,A, and Lehnherr, I. | Are today's fish "14C old" and getting "older" in the northernmost Great Lake (Lake Hazen) in the High Arctic? |
| 34 | Starke,C.W.* Jones,C.L.C, and Frost,P.C | Life history shifts in <i>Daphnia pulex</i> : Interactive effects of water temperature and stoichiometric food quality? |
| 35 | Wynia, A.G.*; Midwood, J.D.; Reddick, D.T.; Jacobs, C.R.; Doka, S.E.; Whillans, T.H. | Fish and invertebrate use of invasive Phragmites in a Great Lakes freshwater delta |
| Life History and Demography | | |
| 36 | Gobin, J. *, Fox, M.G., Lester, N.P., Dunlop, E.S. | How ecological and evolutionary change affect maturation reaction norm estimates |
| 37 | Hauger, M.D.* , Mullen, E., Mckennitt, M., Kroeker, D., Murray, L., Jeffries, K. | Understanding black crappie population characteristics and movement in Whiteshell Provincial Park |
| 38 | Roloson S.D.*; Knysh K.M.; Coffin M.R.S.; Landsman S. J.; van den Heuvel M.R. | The establishment of anadromy in non-native rainbow trout: Insights from acoustic telemetry and otolith microchemistry |
| Limnology at the Landscape Level: Integrating Multiple Stressors and Scales | | |
| 39 | Carew, C.*; Quinlan, R. | Assessing the limnological impacts of multiple-stressors on volume weighted hypolimnetic oxygen (VWHO) in Algonquin Park lakes using a top-bottom approach |

| | | |
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| 40 | Ewins, C.*; Filazzola, A.*; Mahdiyan, O.; Shuvo, A.; Sadid, T.; Moslenko, L.; Sharma, S. | Getting your phyll of data: Assembling a freshwater lake water chemistry database |
| Miles Keenleyside Symposium | | |
| 41 | Church, K.*, Janisse, K., Nguyen-Dang, L., Neff, B., Semeniuk, C. | The predictive power of personality for hatchery raised Atlantic salmon (<i>Salmo salar</i>) |
| 42 | Churchman, E.K.L*, Hain, T.J.A, Knapp, R, and Neff, B.D | Perceived paternity alters parental care behaviour in bluegill sunfish (<i>Lepomis macrochirus</i>) |
| 43 | Goldman, J.A.*; Feyten, L.E.A; Demers, E.E.M; Désormeaux, I.S.; Ramnarine, I.; Brown, G.E. | Prior experience shapes the response of Trinidadian guppies to disturbance cues: evidence from laboratory and field studies |
| 44 | Harris, C.M.*; Janisse, K.; Warriner, T.W.; Capelle, P.M., Love, O.P., Semeniuk, C.A.D. | Predator-avoidance behaviours of juvenile Chinook salmon reared under differing maternal stress and temperature conditions |
| Movement Ecology | | |
| 45 | Munaweera, I.*; Muthukumarana, S.; Gillis, D. M.; Watkinson, D. A.; Charles, C. | Assessing Lake Winnipeg Basin walleye fish movement patterns |
| 46 | Turner, N.*; Rennie, M.; Enders, E.; Watkinson, D.; Klein, G.; Charles, C. | Walleye (<i>Sander viterus</i>) movement ecology in Lake Winnipeg, Canada: past and present |
| Niche Biology | | |
| 47 | Christina Mozzon, Jamie Montgomery, Gretchen L. Lescord*, Thomas A. Johnston | The trophic niche of sculpins (<i>Cottus</i> sp.) in boreal lakes |
| Paleolimnology | | |
| 48 | Persaud, A.A.*; Blais, J.M., Smol, J.P., Cheney, C., Sivarajah, B., Korosi, J.B. | Paleo-ecotoxicology of Yellowknife (NWT) lakes impacted by historic gold mining activities |
| Rivers and Streams: Multi-scale Understanding and Tools | | |
| 49 | Bain, J.*; Rooney, N. | Agriculture VS environmental factors in determining stream metabolism |

| Thermal Biology | | |
|---|---|---|
| 50 | Gillis, D.P.*; Minns, C.K. | Regional application of a seasonal temperature-profile model to estimate fish thermal habitat supply |
| Understanding and Mitigating Impacts of Unconventional Oil Production and Transport on Canada's Aquatic Resources | | |
| 51 | Séguin, J.Y.*; Mason, J.; Hanson, M.; Hollebhone, B.P.; Orihel, D.M.; Palace, V.; Rodriguez-Gil, J.L.; Kimpe, L.; Blais, J.M. | Bioaccumulation and toxicokinetics of polycyclic aromatic compounds and metals in the freshwater mussel <i>Pygandon grandis</i> exposed to water from a simulated diluted bitumen spill in boreal lake enclosures |

Abstracts

Algera, D.A.* , Rytwinski, T.J., Taylor, J.J., Smokorowski, K.E., Bennett, J.R., Harrison, P.M., Bevelhimer, M., Clarke, K., Enders, E., Gibson, D., Janusz, R., Power, M., and Cooke, S.J. Carleton University. **What are the consequences of downstream fish entrainment and impingement associated with hydroelectric dams? A systematic review.** Entrainment, when animals (non-) volitionally pass through hydropower infrastructure (e.g., turbines, spillways), and impingement, when fish become trapped against infrastructure (e.g., screens), can be significant sources of fish injury and mortality at hydropower facilities. While fish entrainment and impingement studies have previously been reviewed, few such reviews follow a stringent systematic review protocol and conduct quantitative analyses. Our objective was to evaluate the existing literature base to determine the magnitude of fish injury and mortality from entrainment and impingement associated with hydroelectric infrastructure in freshwater temperate environments. Quantitative meta-analyses were conducted on fish injury and mortality associated with specific passage routes. Findings are discussed in the context of DFOs Fisheries Protection Program. (Oral)

Allerton, M.*; Jones, N.E.; Melles, S.J.; Schmidt, B.J. Trent University. **Lake outlet effects on stream segments and watersheds.** Lakes are a dominant feature of the landscape in many parts of the world, with impacts on the structure and function of connected rivers and streams that span spatial scales. Reach-scale data on physical and biological conditions in lake outlet streams sheds light on the factors that influence the downstream attenuation of lake effects. At the catchment scale, these results inform the selection of relevant lake attributes to be summarized and quantified in order to capture the influence of multiple lakes on aquatic network structure. Stream-lake network metrics are developed using geographic data for sample catchments in Ontario and are broadly applicable to other lake-rich regions. Their use in modelling applications will advance our understanding of how the presence and spatial pattern of lakes affect key ecosystem processes, habitat characteristics, and patterns of diversity throughout aquatic networks. (Oral)

Anderson, S.* Department of Fisheries and Oceans, Canada. **Incorporating black-swan events into fisheries science.** Black swans are highly improbable events with major consequences that are often only considered predictable in retrospect. Such events define the world around us — from banking collapses to earthquakes. In fisheries, black-swan events could refer, for example, to abrupt declines in fish abundance or massive recruitment events. In this talk, I consider how we can integrate the concept into fisheries science. I explore why we should expect black-swan events and why climate change is likely to increase their occurrence. I compare similarities and

differences between black swans and the related ecological concepts of regime shifts, tipping points, and mass-mortality events, and explore how the concept can be translated into statistical approaches through the use of extreme-value distributions, power laws, and non-linearity. Above all else, black swans necessitate a change in perspective; the goal is not usually to predict such events but to make models and management robust to them. I therefore suggest strategies for how we can introduce such robustness to fisheries science, including incorporating heavy-tailed distributions into process error and projections, integrating extreme events into closed-loop simulations, considering ensembles of stock assessment models with different structural assumptions, and automating the rapid visualization of fisheries data and model fits. (Plenary)

Archibald, D.W.*; R. Rangeley. Oceana Canada. **Fishery Audit 2018: Unlocking Canada's potential for abundant oceans.** Canada's marine fisheries are highly valuable: they are a major driver of our economy, shape our culture and sustain our coastal communities. Yet many of Canada's stocks are depleted. The second annual Fishery Audit uses information published over the last year to update the status of our marine fish and invertebrate stocks and indicators that measure progress toward maintaining or rebuilding Canada's fisheries to healthy levels. There was little change in the health of stocks, only 34% can confidently be considered healthy and there was no change in the percentage that are critically depleted (13%). It takes time for investments in science, policy and transparency to be reflected in measurable changes in the abundance, and much more work needs to be done. Fisheries and Oceans Canada is falling behind on completing work identified in response to the Auditor General's 2016 report, scientific and management information is often published late or not at all, and key policy instruments have not been fully implemented or remain in draft form. Oceana Canada recommends specific actions set Canada's fisheries on the path to abundance, including completing work plans and rebuilding plans, filling data gaps and finalizing a national catch-monitoring policy. (Poster)

Atkins, J.H.L.*; Venkiteswaran, J.J.; Schiff, S.L.; Higgins, S.N.; Emilson, E.J.S. Wilfrid Laurier University. **Characterizing IISD-ELA lakes to predict safe drinking water sources with minimal disinfection by-products.** Chlorination during drinking water treatment removes harmful pathogens, however chlorine reacts with residual dissolved organic matter (DOM) that is recalcitrant to removal and generates potentially carcinogenic disinfection by-products (DBPs). The chemical composition and reactivity of DOM influences its amenability to removal and the subsequent formation of DBPs. The dominant land cover types and hydrology of catchments largely drive DOM concentration and composition in streams and lakes. Longer lake water residence times are among the most important factors to influence DOM through greater in-situ processing. The impact of catchment landscape features and hydrology on controlling the DOM characteristics that influence DBP formation is still largely unknown. Twenty lakes were

chosen at the IISD-Experimental Lakes Area with similar lake surface areas but increasing catchment areas over several orders of magnitude, creating a unique opportunity to study the influence of residence time and catchment gradients on DOM characteristics and the formation of DBPs via chlorination. To improve selection of drinking water sources with a low likelihood of DBP formation, which reduces the costs of water treatment and lowers the harmful health effects of DBPs, this research will develop predictive relationships between catchment characteristics and lake water residence time with the composition of DOM. (Oral)

Auger, B.* , Victor, J., Thienpont, J.R., Kokelj, S.V., and Korosi, J.B. York University. **Permafrost thaw slumping structures zooplankton community composition in western Canadian Arctic lakes.** In areas of ice-rich permafrost, thaw can result in geomorphic disturbances, such as retrogressive thaw slumps that form on the shorelines of lakes, rivers, and coastal areas. Retrogressive thaw slumps can remain active for decades, and resulting in the transport of large volumes of inorganic sediments into adjacent waterbodies. Retrogressive thaw slumps have been increasing in frequency and intensity in recent decades primarily due to climate warming and have important implications for small lake ecosystems that are abundant in permafrost landscapes. We analyzed water chemistry and zooplankton species assemblages in 24 lakes from the Mackenzie Delta Uplands (western Canadian Arctic) using a paired-lake study design, to investigate differences in zooplankton communities between slump-affected and reference lakes. Variation in zooplankton species assemblage is partially explained (18.8%) by limnological variables known to be affected by permafrost thaw slumping, including lake colour, total phosphorus, conductivity, and alkalinity. *Daphnia* spp. and the rotifer *Conochilus unicornis* were not found in highly slump-impacted lakes, suggesting these taxa may be particularly sensitive to limnological changes that occur as a result of thaw slump development. Our results indicate that permafrost thaw slumping has the potential to restructure zooplankton assemblages in Arctic lakes underlain by ice-rich permafrost. (Oral)

Auld, H.L.*; Jacobson, D.P.; Banks, M.A. Oregon State University, USA. **Mate choice of hatchery and wild coho salmon.** Because individuals are limited in their ability to produce offspring, it is important to not mate randomly, but select high quality and/or genetically compatible partners. Mate choice can be important for conservation or population recovery efforts since individuals who choose mates often have greater mating success than those who do not. However, even when given the opportunity to choose mates, reduced reproductive success has been observed in hatchery fish relative to their wild counterparts, suggesting a reduced ability of hatchery fish to select appropriate mates which could be the result of the parental generation of hatchery fish not being able to select their own mates and thus producing less sexually competitive offspring or another selection pressure in the hatchery environment. Using genotyping-by-sequencing, we identify single nucleotide polymorphisms (SNPs) associated with variation in both individual reproductive success and mate pairings in hatchery and wild coho

salmon (*Oncorhynchus kisutch*). Our results indicate that reproductive success differences previously observed between fish of either hatchery or wild origin may correlate with differences in mate choice patterns we infer from their pedigree. (Oral)

Abstracts

Azdajic, M.*; Belzile, N.; Gunn, J.M.; Poulain, A.J.; Blais, J.M. University of Ottawa. **Legacy selenium deposition continues to inhibit mercury accumulation in freshwater organisms in Sudbury, Ontario.** Mining and roasting activities in Sudbury, Ontario have released great amounts of selenium (Se) in the surrounding environment. In 2006, Belzile et al. found that higher Se concentrations in lake water inhibited the assimilation of mercury (Hg) in the freshwater organisms. In the past years, new controls have been put in place to reduce Se emissions coming from the smelter stacks in Sudbury. Our study examined how the Se concentrations have changed after emissions have stopped, and if Se continues to show a protective effect on the accumulation of Hg in tissues of freshwater organisms. Interestingly, our results show that concentrations of Se have increased in lake waters after Se emissions have stopped. Furthermore, our results were able to replicate trends that have been shown in Belzile et al. (2006); Hg concentrations in tissues of zooplankton, amphipods, mayflies, and perch decrease with increasing concentrations of Se in lake water. Results suggest that years after emissions have stopped, the legacy Se deposition is continuing to suppress the accumulation of Hg, a potent neurotoxin, in the food web. (Oral)

Bain, J.*; Rooney, N. Canada. **Agriculture VS environmental factors in determining stream metabolism.** Agricultural growth must meet or exceed the population growth rate and as it does it will put a significant pressure on water and land. Many negative effects of agricultural pressures have been researched in the literature, and this experiment seeks to quantify the effects agriculture intensification has on stream ecosystems. Sites were selected along the north shore of Lake Erie based on their surrounding percentage of agricultural land use and landscape characteristics. Algal growth and respiration of the stream were estimated in this study. These two response variables are measurements of two key energy sources of the carbon cycle of the ecosystem. I looked at multiple environmental variables, agricultural land use (%), canopy cover (%), and temperature (°C), as predictors of environmental change. Results rejected the hypothesis that chlorophyll a will increase with agricultural land use and light, and respiration increased with agricultural land use. Results supported the hypothesis that respiration will increase with temperature. I predicted that (1) chlorophyll a will increase with both agricultural land use (%) and light and (2) respiration will increase with both agricultural land use (%) and temperature (°C). (Poster)

Barber, E.J.*; Schiff, S.L; Venkiteswaran, J.J; Elgood, R.J; Salk, K.R; Higgins, S.N. University of Waterloo. **The use of stable isotopes for examining the base of the food web in Canadian Shield lakes.** The effects of climate change and land use change on watersheds has prompted growing scientific interest as to whether inputs from the terrestrial environment or lake primary productivity drive freshwater ecosystems. Terrestrial organic matter (OM) inputs alter the function of lakes by darkening water and can provide additional nutrients to the system. In-

lake productivity is also an important source of OM. Dissolved inorganic carbon (DIC) produced from photosynthesis at the base of the food web is a vital component of lake ecosystems. To investigate the role of terrestrial and aquatic sources of OM, nine lakes were selected across a dissolved organic matter (DOM) gradient (3.2-14 mg/L) at IISD-Experimental Lakes Area, located in northwestern Ontario. Carbon ($d^{13}C$) and nitrogen ($d^{15}N$) stable isotopes are a useful tool to examine trophic level and energy flow pathways in aquatic food webs. In this study, stable isotopic values of $d^{13}C$ -DIC, $d^{13}C$ -CH₄, $d^{13}C$ - and $d^{15}N$ -POM, $d^{13}C$ - and $d^{15}N$ -DOM, and $d^{13}C$ - and $d^{15}N$ of sediments from May-September will be analyzed to examine the base of the food web. This analysis will lead to a better understanding of aquatic basal resources that accounts for seasonal variability in lakes with different DOM concentrations. (Oral)

Barouillet C., Meyer-Jacob C., Mushet G. R., Hennesy S., Bertin A., Cumming B. F. Queen's University. **Can we track the effect of warming on the cladoceran communities of minimally-impacted lakes?** Freshwater ecosystems are often exposed to multiple-stressors; as such, it is often difficult to study or predict the effect of global warming on lake biota. Fortunately, paleolimnological investigations of minimally-disturbed lakes can help disentangle important drivers of biological change. To study the effect of warming on cladoceran communities, we used a top-bottom paleolimnological approach to compare the cladoceran sub-fossil assemblages from pre-1900 to present using sediment cores from 39 lakes from the ELA and 31 lakes from the Adirondack Park that were selected to be minimally-disturbed from local anthropogenic impacts. Results from our study indicate that, although both regions have experienced a $\sim 1.5^{\circ}C$ increase in MAAT since the 1900s, the cladoceran communities are changing in opposite directions since pre-industrial time in the two regions. While *Daphnia* relative abundance declined in 70% of the Adirondack lakes, it increased in 50% of the ELA lakes since pre-industrial time. Combined with modern limnological data, and the reconstruction of TOC/DOC concentration, we suggest that DOC is the primary driver of changes of the cladoceran communities, with *Daphnia* declining in the lakes that became clearer. Our study gives insight into the implications of studying the effect of climate change in minimally-impacted lakes. (Oral)

Bassi, A., Love, O.P., Cooke, S.J., Madliger, C.L.*. Carleton University. **The fish perspective of artificial light at night.** Almost all organisms rely on natural cycles of light and dark to provide reliable cues for diverse aspects of their ecology such as foraging, growth, reproduction, and migration. As a result, artificial light sources can have a variety of negative consequences for both plants and animals. Such effects are predicted to become more widespread as the geographic extent of artificial light at night (ALAN) increases by 6% per year. In particular, with one quarter of the human population living within 100 kilometres of a coastline, there is great potential for ALAN to influence the physiology, behaviour, and fitness of fish. We quantitatively illustrate that fish have been under-represented in the scientific literature that documents and interprets the effects of ALAN in comparison to birds, mammals, reptiles, and invertebrates. To understand where research has been focused, we partition studies on ALAN in fish by physiology, behaviour, fitness, and other aspects of general ecology and summarize the major research findings in each of these categories. Finally, we provide recommendations for future research that can aim to understand how changing intensity, coverage, and spectral

compositions of artificial light could have downstream consequences for fish health and persistence. (Poster)

Bauman, J.*; Rooney, N. University of Guelph. **Seasonal patterns of phosphorus movement from terrestrial to aquatic systems in an agriculturally-impacted landscape.** Eutrophication is currently thought to be one of the leading impairments to freshwater quality in North America. Lake Erie, one of the five Great Lakes, has experienced ongoing issues with eutrophication and excessive nutrient loading, which in recent years has been primarily due to increasingly high agricultural activity in its surrounding watershed. Over-application of manure and fertilizer that is high in nutrients such as phosphorus and nitrogen can result in these nutrients being lost to aquatic systems via overland surface runoff during precipitation or snow melt events, or through soil leaching into groundwater. There is therefore a need to quantify the sources and pathways of nutrient loss in the landscape. This project will take a year-long approach to examine phosphorus concentrations in surface water, groundwater, surface runoff, soil, and streambed sediments from headwater streams. This information can be used to develop nutrient budgets and models relating land-use activity to nutrient loss pathways throughout the landscape, which is knowledge that will be helpful in developing solutions to the ongoing and significant issue of nutrient pollution in freshwater systems. (Oral)

Bayse, S.M.*; McCormick, S.D.; Castro-Santos, T. US Geological Survey, USA. **How energy content and temperature affect American shad swimming performance.** Over the course of the adult American shad (*Alosa sapidissima*) spawning migration temperatures increase and energetic reserves gradually decrease, and how these seasonal changes affect sprint swimming is currently unknown. This study evaluated American shad sprint swimming performance in a flume against high flow velocities (2.5-3.7 m/s) during the upstream migration period (April-May; temperatures 11.1-21.4° C). Swimming performance was determined by motivation to enter a velocity barrier (attempt rate) and swimming endurance (swim speed fatigue time relationship). American shad did not make attempts at low temperatures, and attempt rate gradually increased throughout the migration as temperatures warmed. American shad displayed two distinct modes of non-sustained swimming and endurance was different between sexes. Females displayed mode 1 swimming more often at warmer temperatures and displayed a lower endurance at warm temperatures for long fish. Male swimming was primarily at mode 2 and was affected by swimming speed, length, and energy content. Our results indicate that American shad motivation and swimming endurance changes over the course of the migration as conditions change, potentially limiting their ability to pass barriers. (Oral)

Bell, M.*; Saleem, S.; Korosi, J.; Kimpe, L.; Blais, J.M. University of Ottawa. **Sedimentomics: A systematic biomarker discovery method with applications for paleolimnological reconstructions of Arctic treeline dynamics.** Biomarkers are organic molecules that can be used as proxies to reconstruct historical, ecological, archaeological and climatological conditions from paleoarchives like lake sediments. Biomarkers are very useful indicators for past climate conditions and have been used to train predictive models for future climate changes. The focus of this work is to develop a systematic biomarker discovery method for paleolimnology by adapting “omics” methods (i.e. metabolomics, lipidomics, etc.). We are currently applying this

method to the Canadian Arctic treeline. The Arctic treeline is sensitive to climate changes, but can also influence the magnitude and direction of changes in climate. In order to identify treeline-specific biomarkers, we used sediment cores from 61 lakes from northern Canada. The samples were extracted using a metabolomics-derived untargeted method and analyzed using high resolution accurate mass spectrometry to determine the sedimentary molecular composition. This method allowed us to differentiate the molecular composition of sediment organic matter between boreal and Arctic tundra ecosystems and identify key potential biomarkers. This project should have many future applications and can be used to expand and improve multi-proxy approaches used when investigating key environmental questions pertaining to environmental and climatic changes. (Oral)

Benoit, D.M., Jackson, D.A, and Chu, C. University of Toronto, Canada. **Partitioning fish communities into guilds for ecological analyses: an overview of current approaches and future directions.** In recent decades, the use of guilds as a unit of study has grown increasingly common in the field of aquatic community ecology. A major strength of the guild approach is its ability to simplify community analysis by aggregating species with similar roles or functions into groups. These groups can then be used to study a number of important ecological concepts, including functional diversity, community response to disturbance, and food web dynamics. Common methods used to distinguish fish guilds include those based on trophic level, habitat use, and morphology. Despite increased use, the guild approach has a number of major limitations that are often left unaddressed. For instance, guild membership can be based on subjective criteria that are arbitrarily chosen, leading to inconsistencies across studies. Additionally, studies using the guild approach generally ignore ontogenetic changes in diet and habitat use and do not fully capture the complexity of aquatic communities. In this study, we review the current methods used to partition fish communities into guilds, determine what data are required, and examine the types of questions that can be answered through guild analysis. Through this process, we highlight approaches that can be used to address the aforementioned limitations and provide recommendations for future work in this field. (Oral)

Biedak, N.R.; Scott, R.J.*; Baker, J.A.; Foster, S.A. Grenfell Campus, Memorial University of Newfoundland. **Variation in antipredator armor among populations of Newfoundland threespine stickleback.** Extensive variation in morphological traits has been demonstrated for populations of threespine stickleback (*Gasterosteus aculeatus*) from the west coast of North America (British Columbia and Alaska). In contrast, the limited number of published studies on stickleback from the east coast of North America suggest that there is relatively little variation among populations on the Atlantic coast. We examined antipredator defense structures (dorsal spine length, pelvic spine length, pelvic girdle development, lateral plate number and size) for stickleback from 29 marine and freshwater populations in western Newfoundland. Variation in antipredator defense morphology among western Newfoundland stickleback populations parallels that of western North America; marine samples had robust antipredator armor that did not vary from location to location and freshwater populations varied in almost all traits examined. Surprisingly, freshwater populations in western Newfoundland demonstrated the complete range of armour variability found among populations in British Columbia and Alaska,

from robust antipredator armor to drastically reduced antipredator armor, including a population that has lost the pelvic girdle and associated spines. (Oral)

Blair, S.G.*; Gutowsky, L.F.G. and M.G. Fox. Trent University. **Brook trout (*Salvelinus fontinalis*) habitat use and movement in urban streams.** Brook trout populations have been rapidly declining due to urban development, deforestation, and climate change, which primarily limits them to headwater streams. Current knowledge of brook trout ecology primarily focuses on their nonnative range, undisturbed environments in their native range, or in the presence of invasive species. However, little is known about habitat use and movement of wild brook trout in small urban streams, which puts local populations at risk given ongoing urban disturbance. The objective of this research is to assess the seasonal influence of environmental and biological factors associated with juvenile and adult brook trout habitat use and movement within urban streams. Habitat use will be determined on a seasonal basis using a mark-recapture study design in three Central Ontario streams to develop a model for seasonal habitat selection by brook trout. Seasonal movement will be assessed using radiotelemetry to determine locations of 60 adult brook trout between summer and winter over two years, and what influences movement on a weekly basis. This study will advance current knowledge of brook trout ecology and will be used to inform municipalities on crucial timing and location of brook trout habitat refuge, to help seasonally manage urban streams during urban development. (Oral)

Blais, J.M.*; Orihel, D.M.; Rodriguez-Gil, J.L.; Hollebhone, B.; Palace, V.; Hanson, M. University of Ottawa. **The BOREAL Project: Overview of an experimental oil spill to limnocorrals at the IISD Experimental Lakes Area.** Recent reports highlight significant knowledge gaps on the behaviour, fate, and effects of diluted bitumen (dilbit) to aquatic systems resulting from pipeline breaches. The BOREAL project (Boreal lake Oil Release Experiment by Additions to Limnocorrals) was developed to address these knowledge gaps. The BOREAL study was divided in two parts: (1) a pilot study in 2017 consisting of three 2 m diameter microcosms; and (2) a large-scale study in 2018 consisting of nine large mesocosms (10 m diameter), where diluted bitumen was added to assess its fate, behaviour, and toxicity in a natural setting. The 2018 study was performed in a regression design, with 2 controls and 7 oil treatments ranging from 1.6 L to 160 L of dilbit added to $\sim 157 \text{ m}^3$ of water, resulting in oil:water ratios in treatments between 1:100,000 to 1:1000. We monitored the physical and chemical properties of the diluted bitumen in water, physical and chemical water quality variables, floral and faunal community responses, and toxicity of water in each of the limnocorrals prior to, and for a period of 12 weeks following the spill. Here we present a summary of findings from the 2017 pilot study and some early results from the 2018 study. (Oral)

Bontje, J. E.*; Jackson, D. A.; Drake, A. R. University of Toronto. **Species co-occurrence modelling: the influence of biotic factors on Lake Chubsucker (*Erimyzon sucetta*) at multiple scales.** Species distribution models (SDMs) can be an effective way to explore the influence of environmental factors on aquatic species, potentially leading to strong inferences about habitat requirements and community structure. However, most species distribution models focus on abiotic factors (e.g. water temperature, depth), while ignoring biotic information such as the

incidence of prey, competitions or predators. These limitations are especially prevalent for imperiled species. Here, the majority of SDMs omit biotic factors, even though their inclusion but could provide substantial insight about the prevalence of antagonistic or synergistic interactions and their effect on species persistence. We evaluate whether the inclusion of biotic factors can increase the predictive validity of SDMs at multiple scales, focusing on whether biotic factors lead to new hypotheses about structuring influences of Lake Chubsucker (*Erimyzon sucetta*), an endangered warm water fish found in coastal wetlands of the lower Great Lakes. (Poster)

Boreux, M.P.*; Lamoureux, S.F.; and Cumming B.F. Department of Civil and Environmental Engineering, Western University, London, ON. Department of Geography and Planning, Queen's University, Kingston, ON. Department of Biology, Queen's University, Kingston, ON. **Holocene water balance variability and change in Northeastern Ontario, Canada reconstructed from lake sediment carbonate stable isotopes and XRF data.** Climate models suggest that temperatures will increase significantly by the end of the century. Similar patterns were observed during the mid-Holocene when the American prairie region displayed drier conditions while the American northeast was wetter. Published pollen records in northeast Ontario give conflicting perspectives and, it remains poorly understood whether this period was drier or wetter in the area. Thus, there is a need to develop multiproxy long paleohydrological records to better understand future climate risks on freshwater systems. Sediment cores were retrieved from two adjacent lakes near Timmins, Ontario, one located upland and the other embedded in a regional aquifer. Sediment cores were dated with radiocarbon and analyzed for carbonate stable isotopes ($\delta^{18}\text{O}$ and $\delta^{13}\text{C}$) and XRF data to reconstruct past lake-water balance and water levels. Both lakes had distinctly lower levels between 9,000 and 7,000 cal. BP. Water levels increased abruptly between 7,000 and 5,000 cal. BP where they were at their highest for the past glacial period. The isotopes are consistent with the XRF data and previous regional records, suggesting that northeastern Ontario was synchronous with the American northeast. Water levels subsequently decreased slightly from 5,000 cal. BP onwards to reach intermediate levels in a long-term perspective. (Oral)

Boreux, M.P.*; Roy, J.W.; Yates, A.G.; Robinson, C.E. Department of Civil and Environmental Engineering, Western University, London, ON. Department of Geography and Planning, Queen's University, Kingston, ON. Water Science and Technology Directorate, Environment and Climate Change Canada, Burlington, ON. Department of Geography, Western University, London, ON. **Assessment of groundwater-stream water interactions and stream nutrient status in agricultural landscapes in the Upper Thames River Watershed, Ontario.** Nutrient enrichment of surface waters by anthropogenic phosphorus compounds degrades water quality in the Laurentian Great Lakes and their tributaries, causing the loss of economic, recreational and ecological benefits. Current mitigation efforts in agricultural landscapes focus mainly on reducing surface runoff pathways that deliver nutrients to adjacent streams. The importance of the groundwater pathway in delivery nutrients to streams in agricultural areas remains unclear with the processes that govern this pathway not well understood. Therefore, there is a need to acquire new scientific knowledge on the contribution of groundwater inputs on surface water nutrient budgets in agricultural landscapes. Two adjacent headwater streams in the upper

Thames River watershed, Ontario, were surveyed every ~200 m during summer baseflow conditions for water stable isotopes ($\delta^{18}\text{O}$ and $\delta^2\text{H}$) and radon-222 to identify groundwater-surface water connectivity along the streams. This information was compared with stream chemistry data including orthophosphate, total phosphorus, artificial sweeteners, ion chemistry, stream gauging and temperature. Study findings will address spatial patterns of groundwater discharge in streams with respect to local hydrogeological conditions, land use and landscape characteristics and investigate a combination of methods to distinguish groundwater discharge zones and potential phosphorus inputs to streams from groundwater. (Poster)

Burbank, J.*; Finch, M.; Drake, D.A.R. & Power, M. University of Waterloo. **Diet and isotopic niche of Eastern Sand Darter (*Ammocrypta pellucida*) at the northern edge of its range: a test of niche specificity.** Niche specificity can predispose species to population declines during periods of resource limitation, yet niche specificity from a dietary perspective is poorly known for many small-bodied freshwater fishes. Applying a two-pronged approach based on stable isotope and stomach content analysis, we examine the diet and the isotopic niche size of the Eastern Sand Darter (ESD), a threatened species under the Canadian Species at Risk Act. As with previous studies, ESD consumed a variety of organisms including Chironomidae, Cladocerans, Ostracoda, and various other benthic organisms such as Ephemeroptera, although the proportional contribution of food items differed based on the method of investigation. Stable isotope results highlighted ESD exhibit a relatively narrow isotopic niche, indicating increased sensitivity to environmental and anthropogenic disturbance if prey resources become limiting. Moreover, based on the overlap of the isotopic niche of co-occurring species, ESD likely experience competitive interactions for food resources with other benthic fish, demonstrating that competition may further contribute to negative population impacts during periods of prey scarcity. We highlight that developing an understanding of a species feeding ecology and dietary niche provides useful insight into the resilience and potential population level responses to environmental and anthropogenic disturbances that modify prey availability. (Oral)

Burke, S.M.*; Branfireun, B.A.; Laske, S.M.; Zimmerman, C.E.; Swanson, H.K. University of Waterloo. **Fish growth rates and lake sulphate control mercury levels in Ninespine stickleback (*Pungitius pungitius*) on the Arctic Coastal Plain of Alaska.** Mercury (Hg) is a neurotoxin that can be harmful to human and animal health. To make accurate predictions about how environmental change will affect fish mercury concentrations, we must first understand drivers of current spatial variation in mercury (Hg) bioaccumulation. In 2016, we sampled six lakes across a physico-chemical gradient on the thermokarst-rich Arctic Coastal Plain of Alaska. Analyses were conducted to determine the best predictors of methyl Hg (MeHg) levels in Ninespine stickleback (*Pungitius pungitius*). The best biotic predictor of length-adjusted mean MeHg concentration was growth (i.e., age-at-standardized-size, partial $R^2 = 0.92$), and the best abiotic driver was lake sulphate concentration (partial $R^2 = 0.89$); together, these two covariates accounted for nearly all of the variability in length-adjusted mean MeHg concentration ($R^2_{\text{adj}}=0.96$). There is also evidence to suggest that routes of MeHg into lake food webs vary in response to degree of catchment influence. Lakes that are more autochthonous appear to support a grazing food web with lower mercury concentrations whereas lakes that are more

allochthonous appear to support a detrital/biofilm foodweb with higher mercury concentrations. The different routes and accumulation rates of MeHg into the food webs we studied could result in varied responses to climate-related change. (Oral)

Bzonek P.B.*; Edwards, P.D.; Hasler, C.T.; Suski, C.D.; Boonstra, R.; Mandrak, N. E. University of Toronto Scarborough. **Investigating non-physical barriers and the role of inter-individual fish variation.** Non-physical barriers can be used in conservation to limit the dispersal of invasive fishes without altering the flow of a watershed. It is important to consider not only how non-barriers affect dispersal, but also how barriers influence and are influenced by broader behavioural and physiological contexts. Here we motivated Common Carp within a choice arena to enter a novel environment by degrading their currently occupied environment with carbon dioxide. We then opposed the fish departure by introducing complex sound and strobe lights as aversive stimuli along the dispersal path. Additionally, we investigated whether the aversive stimuli would activate the hypothalamic-pituitary-interrenal axis through measuring plasma cortisol. Finally, we tested whether individuals within a population would vary in the strength of their avoidance response to a non-physical barrier stimulus. The acoustic and stroboscopic stimuli detained invasive Common Carp from departing the increasingly unfavourable environment, but blood cortisol levels did not differ between treatments. There were consistent-individual-differences for the inflow carbon dioxide concentrations required to motivate Common Carp to disperse across the aversive stimuli. Inter-individual variation in barrier avoidance could lead to barriers becoming behavioural or physiological filters where some individuals are more likely to pass than others. (Oral)

Cahill, C.L*, Paul, A.J, and J.R. Post. University of Calgary, Canada; Alberta Environment and Parks; Canada. **Is there evidence of density dependent somatic growth in Alberta's walleye lakes?.** Density dependent somatic growth is often a key driver of demography in stage-structured populations. Consequently, determining if growth rates vary with density is important for examining tradeoffs such as managing for large numbers or large sizes of fish. Our objective was to explore this topic using the Alberta Walleye fishery as a case study. We used age and growth data from a standardized province-wide Fall Walleye Index Netting program and a reparameterized version of the von Bertalanffy growth equation to explore the role of density (average biomass per net) on initial Walleye growth rates (cm/yr). We developed a candidate set of nonlinear mixed-effects models to test this hypothesis at the provincial scale using Template Model Builder, which is a powerful tool for exploring spatial patterns in ecological data. Other tools for spatial modeling (e.g., INLA or MCMC) are limited to linearizable models or have long run times, respectively. Our candidate set included models with standard random effects and models incorporating spatially-correlated random effects. Spatially-explicit random effects were estimated using the Stochastic Partial Differential Equation approach and the Matérn covariance function. Finally, we discuss the relevance of addressing spatial dependence to fundamental questions of Walleye management in Alberta. (Oral)

Cantera, K.C.*, McLaughlin, R.L. University of Guelph. **Genetic effects and plastic responses on brain morphology of brook charr (*Salvelinus fontinalis*) differing in foraging style.** The proximate mechanisms of phenotypic diversification within populations are complex. In

polymorphic fishes, differences in behaviour are often related to genetic or plastic differences in external morphology. We tested if internal differences in brain morphology of brook charr (*Salvelinus fontinalis*) are shaped by genotype differences and phenotypic plasticity. Some young-of-the-year (YOY) brook charr are sedentary, feeding on crustacean prey from lower part of the water column. Others are active, feeding on insect prey at the water surface. Sedentary individuals have a smaller telencephalon, the brain region involved in space use, than active individuals. YOY brook charr from 24 families from migrant and resident grandparents from Lake Superior were raised in conditions favouring a sedentary or an active foraging style. Afterward, volumes of key brain regions were quantified. Total brain weight and relative volumes of the telencephalon, optic tectum, cerebellum, olfactory bulb, and hypothalamus varied with environmental conditions and between families. Some of these brain differences were correlated with behaviour in feeding trials and with the family history of migratory behaviour. Our findings suggest that genetic and plastic influences on brain morphology and behaviour are important aspects of the proximate mechanisms influencing phenotypic diversification in wild fish. (Oral)

Carew, C.*; Quinlan, R. York University. **Assessing the limnological impacts of multiple-stressors on volume weighted hypolimnetic oxygen (VWHO) in Algonquin Park lakes using a top-bottom approach.** Algonquin Park has many lakes which are being affected by multiple stressors. Climate warming may cause reductions in the deepwater (hypolimnetic) oxygen concentration of lakes, furthermore, these effects may be enhanced due to other anthropogenic stressors, such as shoreline cottage development. These effects may reduce the habitat available for important fish like lake trout, and brook trout, which require cold, oxygenated water. This study used a top-bottom paleolimnological approach to compare present-day assemblages of larval Chironomidae (Insecta: Diptera) compared to pre-industrial (< 1850 AD) assemblages, to determine if long-term patterns of change in assemblage structure were different in 22 lakes with shoreline development (private cottages) versus 33 reference lakes with no development. Ordinations will be used to identify the gradients which significantly affect modern chironomid distributions (from the top sediments). A volume weighted hypolimnetic oxygen (VWHO) inference model will be developed using a training set of modern chironomid assemblages. The model will enable the inference of historic VWHO using the chironomid proxies found in the bottom sediment. Modern and historic VWHO values will then be used to assess changes in VWHO over time, and to determine whether these changes are significantly different in cottage lakes. Preliminary results will be presented. (Poster)

Cederwall, J*; Black, T; Blais, J.M.; Hanson, M.L.; Hollebhone, B.; Palace, V.P.; Rodríguez-Gil, J.L.; Greer, C.W.; Maynard, C.; Ortmann, A.C.; Rooney, R.C.; Stoyanovich, S.; Orihel, D.M. Queen's University. **Diluted bitumen spills and the boreal freshwater ecosystem: a microcosm study.** Unconventional oil from the Canadian oil sands is currently transported across North America and additional pipelines have been proposed to meet growing production capacity. One of the most common forms of transported oil is diluted bitumen. Dilbit, is a mixture of bitumen with a diluent used to reduce the viscosity of bitumen, facilitating transport. In marine environments, dilbit behaves differently than conventional oil but it is unclear how oligotrophic freshwater

ecosystems will respond should a spill occur. In the summer of 2017, we conducted two simulated dilbit spills in 1400 L, land-based microcosms at the International Institute for Sustainable Development - Experimental Lakes Area (IISD-ELA) and monitored planktonic communities and sediment for 11-days. Zooplankton and phytoplankton species diversity and biomass declined following the spill. Within the phytoplankton, dinoflagellate and chrysophyte species were particularly sensitive and may represent possible bioindicators in boreal systems. Based on 16S rRNA gene amplicon sequencing, the composition of microbial communities in the water column shifted following dilbit addition, but sediment microbial communities remained relatively unchanged. Through this microcosm experiment, we have begun to investigate several potential impacts of a dilbit spill in a freshwater ecosystem, while generating new questions that will be the objectives of future studies. (Oral)

Chapman, L.J. McGill University. **Effects of dual stressors on energetics and performance of African equatorial fishes.** Two stressors that are likely to have strong interactive effects on fishes (and fisheries) are thermal stress associated with climate warming and hypoxia because both affect the aerobic metabolism of fishes. Here, I present results of a series of acclimation and rearing experiments that explore effects of temperature and hypoxia on energetics, behavior, performance (e.g., aerobic scope) and morphological traits in the African cichlid *Pseudocrenilabrus multicolor*. Acclimation to elevated water temperatures induced compensation in thermal tolerance in *P. multicolor*. F1 offspring reared in four treatments (low or high oxygen; cool or hot temperature) showed developmental plasticity in morphological traits (e.g., gill size), behaviour, energetics, and performance; and development under hypoxia modulated negative effects of acute thermal stress on swim performance. Fish reared under hot, hypoxic conditions showed reduced brain mass, but there was no effect of hypoxia on brain size under cool conditions. A positive relationship between brain mass and aerobic scope was observed across treatments, suggesting that AS may be a useful predictor of variation in aerobically demanding organs. The results of these studies highlight the need for integrating multiple phenotypic traits and multiple stressors into assessments of potential impacts of climate change on fish populations. (Oral)

Chavarie, L*; Howland, K.L.; Harris, L. N.; Hansen, M.J.; Harford, W.J.; Gallagher, C.P.; Baillie, S.M.; Malley, B.; Tonn, W.M.; Muir, A.M.; Krueger, C.C. Canada. **From top to bottom: Do Lake Trout diversify along a depth gradient in Great Bear Lake, NT, Canada?** Depth is usually considered the main driver of Lake Trout intraspecific diversity across lakes in North America. Given that Great Bear Lake is one of the largest and deepest freshwater systems in North America, we predicted that Lake Trout intraspecific diversity to be organized along a depth axis within this system. Thus, we investigated whether a deep-water morph of Lake Trout co-existed with four shallow-water morphs previously described in Great Bear Lake. Morphology, neutral genetic variation, isotopic niches, and life-history traits of Lake Trout across depths (0-150 m) were compared among morphs. Due to the propensity of Lake Trout with high levels of morphological diversity to occupy multiple habitat niches, a novel multivariate grouping method using a suite of composite variables was applied in addition to two other commonly used grouping methods to classify individuals. Depth alone did not explain Lake Trout diversity in Great Bear Lake; a distinct fifth deep-water morph was not found. Rather, Lake Trout

diversity followed an ecological continuum, with some evidence for adaptation to local conditions in deep-water habitat. Overall, trout caught from deep-water showed low levels of genetic and phenotypic differentiation from shallow-water trout, and displayed higher lipid content (C:N ratio) and occupied a higher trophic level that suggested an potential increase of piscivory (including cannibalism) than the previously described four morphs. Why phenotypic divergence between shallow- and deep-water Lake Trout was low is unknown, especially when the potential for phenotypic variation should be high in deep and large Great Bear Lake. Given that variation in complexity of freshwater environments has dramatic consequences for divergence, variation in the complexity in Great Bear Lake (i.e., shallow being more complex than deep), may explain the observed dichotomy in the expression of intraspecific phenotypic diversity between shallow- vs. deep-water habitats. The ambiguity surrounding mechanisms driving divergence of Lake Trout in Great Bear Lake should be seen as reflective of the highly variable nature of ecological opportunity and divergent natural selection itself. (Oral)

Chemali, C.*, Creed, I.F., Trick, C. G. Western University, Canada. **Effect of dissolved organic matter on red and green phenotypes of *Pseudanabaena***. Human activities through the burning of fossil fuels are altering our atmosphere resulting in climate changes, including increased temperatures and changes in precipitation and runoff from watersheds to lakes. These changes are having significant effects on lakes, including elevated dissolved organic matter (DOM) and nutrient loads to lakes that are likely to affect phytoplankton communities. An unpredicted cyanobacterial bloom in Dickson Lake (45°48'N, 78°13'W) located within Algonquin Park, Ontario, occurred that was dominated by an *Anabaena* (*Dolichospermum*) sp. but included red and green phenotypes *Pseudanabaena* sp. Dickson Lake. The rich diversity of accessory pigments observed among phytoplankton allows species to exploit different parts of the visible light spectrum, and thus provide opportunities for niche-differentiation. Phycoerythrin (PE)-rich cyanobacteria - red phenotype - absorb in the green-yellow spectrum, whereas phycocyanin (PC)-rich - green phenotype - absorb light in the orange-red spectrum. Contrarily, increased subsidies of terrestrially-derived dissolved organic matter (brownification) results in the rapid attenuation of shorter wavelengths resulting in the prevalence of longer wavelengths (i.e., orange and red). Here, we will be examining the physical and chemical effects of Suwannee River NOM, a DOM proxy on the growth, yield and photosynthetic efficiency of the red and green phenotypes of *Pseudanabaena*. (Oral)

Cheng, Z.*, H. A. Einarsson, S. Bayse, B. Herrmann, P. Winger. Fisheries and Marine Institute of Memorial University. **Size selectivity of traditional and knotless diamond codends in the Iceland redfish (*Sebastes* spp.) fishery**. The size selectivity and usability of two diamond mesh codends, a traditional two-panel 135 mm mesh codend versus an experimental four-panel 110 mm ultra-cross knotless mesh codend, was compared using the covered codend method in the Iceland redfish fishery (*Sebastes norvegicus* and *S. viviparous*). Results showed that there was no significant difference in size selectivity between the codends at lengths greater than 29 cm for *S. norvegicus* and 19 cm for *S. viviparous*. At smaller lengths, size selectivity was undetermined due to small catches at those sizes. For *S. norvegicus*, both codends demonstrated a high retention ratio (approximately 93%) above the minimum reference length (MRL; 33 cm), but also had a high retention below MRL (>83%). However, the actual proportion

of catch below MRL was low (< 0.02). This study concludes that the knotless codend does not improve the size selectivity or exploitation pattern in the Iceland redfish fishery and both codends will retain large proportions of undersized fish if present on fishing grounds; however, few undersized fish were present in the study area. (Oral)

Church, K.* , Janisse, K., Forest, A., Heath, J., Heath, D., Semeniuk, C. University of Windsor. **Behavioural phenotypes of sneaker male Chinook salmon in fresh and saltwater.** Alternative reproductive tactics (ARTs) are widespread in fishes. In salmonids, males may either grow up to become a parental male, or hooknose, which actively competes for females, or become a sneaker male, or jack, which “sneak” copulations from females actively mating with hooknose males. Jack males are undesirable in aquaculture, as they expend energy into reproduction rather than growth, and are consequently unpalatable to consumers, yet still require the same investment of food resources to raise. Previous work shows juveniles experience accelerated growth prior to becoming jacks, which may be due to an increase in aggressive behaviour. We tested the behaviour of aquaculture Chinook salmon (*Oncorhynchus tshawytscha*) as juveniles in fresh water and as adults in salt water ($n=72$) to investigate if juvenile behaviours predict jacking. Additionally, we also tested whether jacking rates were affected by competitor density (100, 50 or 35 fish), food ration (high vs low) or sire (jack or hooknose). Jacks were identifiable by their behaviour only in saltwater, although freshwater behaviour predicted jacking rates indirectly; more jacks were produced at higher densities with lower food, and from jack sires. Our study suggests that juvenile behavioural screenings have the potential to reduce jacking costs in aquaculture. (Oral)

Church, K.* , Janisse, K., Nguyen-Dang, L., Neff, B., Semeniuk, C. University of Windsor. **The predictive power of personality for hatchery raised Atlantic salmon (*Salmo salar*).** Personality, or consistent behavioural differences between individuals, are often a consequence of risk-reward and/or life history trade-offs. For example, although bold and aggressive behaviour may increase resource access, it also increases the risk of predation or injury; additionally, bold, aggressive individuals may also exhibit a fast life history strategy, with higher metabolic rates and faster growth. We tested the predictive power of personality in determining predation risk and metabolic rate for hatchery raised juvenile Atlantic salmon (*Salmo salar*). We first assessed personality using a series of videotaped trials, where we recorded the response of individual fish to the presence of a novel object, a mirror, and food, on four separate occasions. Individually-marked fish were then split into two groups. The first group of fish were placed individually into intermittent flow-through respirometry chambers overnight to assess metabolic rate, and to identify any associations with personality. The second group of fish was used in a group mesocosm experiment to assess the accuracy of personality tests in predicting risk-taking, social and foraging behaviour in the presence of a caged predator; the predator was then released to assess the relationship between personality and survival for hatchery salmon, with implications for restoration success. (Poster)

Churchman, E.K.L*, Hain, T.J.A, Knapp, R, and Neff, B.D. University of Western Ontario. **Perceived paternity alters parental care behaviour in bluegill sunfish (*Lepomis macrochirus*).** Parental care is energetically costly, and theory predicts that parents should alter their level of

care to reflect the reproductive value of their brood. Cuckoldry reduces the relatedness of a parent to their brood, thereby reducing its value. Kin recognition - the ability to distinguish between kin/non-kin - allows parents to adjust their care based on the value of the brood. The bluegill (*Lepomis macrochirus*) mating system is characterized by cuckoldry. Nest-tending males have previously been shown to be able to assess relatedness of newly-hatched larvae but not of eggs. In the current study, we tested the hypothesis that parental males adaptively adjust their parental care in response to changes in perceived paternity. We directly manipulated paternity by swapping eggs between nests, and recorded parental care behaviours pre- and post-hatch. We found that parental males with higher paternity increased their aggression in protecting their brood post-hatch, while males with experimentally reduced paternity did not. We also sampled plasma and brain tissue to investigate levels of key reproductive hormones and receptors, including prolactin and 11-ketotestosterone, to assess their roles in kin recognition and changes in parental care behaviour. Our goal is to understand both the mechanisms and evolutionary consequences of parental care decisions. (Poster)

Cogliati, K.M.*, Schreck, C.B., Noakes, D.L.G. Oregon State University, USA. **Can early life history traits predict juvenile migration timing in Chinook Salmon?** Variation in early life history traits often leads to differentially expressed morphological and physiological characteristics. These may also be indicative of future behavioral phenotypes. We investigated whether variation in egg size, emergence timing and vertical self-sorting behaviour influenced subsequent morphology associated with downstream migration timing in juvenile spring Chinook Salmon, *Oncorhynchus tshawytscha*. We used landmark-based geometric morphometrics to evaluate differences in body shape between groups. Egg size appears to drive morphological differences, with evidence for an absolute rather than relative effect. Fish from small eggs were morphologically more similar to fall migrants while fish from large eggs were morphologically more similar to those that migrate the next spring. The body morphology of fish that prefer the surface or bottom location in a tank soon after emergence also correlates with a difference in migration timing. Given our findings, early growth rate may be an important factor in determining future migratory phenotypes. (Oral)

Cole, K.S.*. University of Hawaii at Manoa, HI. **Sex and the undecided fish.** Traditionally fishes can be divided into species that are either constant-sexed (i.e., gonochoric) or sexually plastic (hermaphroditic). The genetic mechanisms that regulate sexual development in hermaphroditic fish species are still not completely understood. Among gonochoric taxa, gene regulatory pathways critical for early gonad development can differ and growing evidence indicates that the acquisition of labile sexual patterns among fishes has been achieved de novo numerous times. And in many cases where hermaphroditism occurs, it is an ancestral trait. Gobies (family Gobiidae) present an unusual case in which both hermaphroditic and gonochoric taxa occur. Experimental manipulation of functional sex, coupled with gonad histomorphology and an investigation of gene expression patterns associated with shifts in sexual function within gobies is now being applied to determine how hermaphroditism may have evolved with the Gobiidae. Early results support the hypothesis of the independent evolution of sexual plasticity at least once within gobiids. (Oral)

Coleman, K.A.*; Korosi, J.B. York University. **Investigating Landscape Drivers of Spatial Variability in Subarctic Lakes Responses to Permafrost Thaw.** Aquatic ecosystems at the southern limit of permafrost are highly sensitive to climate warming through dramatic alterations of the landscape resulting from permafrost degradation. In the southern Northwest Territories (NT), permafrost is typically restricted to forested peat plateaus that are elevated above the surrounding wetland complex. As mean annual air temperatures approach 0°C, permafrost thaw results in the collapsing of peat plateaus, waterlogging of trees, and the alteration of plant communities. These landscape alterations can impact aquatic ecosystems through changes in hydrological connectivity and biogeochemical cycling, as the quantity and composition of terrestrial organic matter run-off changes, which in turn can affect important aquatic ecological processes. My research integrates paleolimnology and remote sensing to track ecosystem responses to permafrost thaw in small lakes in the Dehcho region of the southern Northwest Territories, including the Tathlina Lake watershed, near the community of Kakisa, and the Scotty Creek basin, near Fort Simpson. I am investigating the range of spatial variability in lake ecosystem response to thawing permafrost, and how catchment characteristics drive this spatial variability. This multi-disciplinary approach will contribute important advancements in our understanding of how permafrost thaw impacts aquatic ecosystems and how aquatic ecosystems will change in the future. (Oral)

Connors, K.*, Anderson, P., Hughes, C. Minnow Environmental Inc.. **Monitoring of a remediated stream impacted by the 2014 Mount Polley Tailing Storage Facility breach.** Following the 2014 foundational failure of the perimeter embankment of the Mount Polley Tailings Storage Facility, Hazeltine Creek was drastically altered. The breach released approximately 25 million m³ of debris, which resulted in Hazeltine Creek being both physically and potentially chemically unsuitable as fish habitat. Barriers to fish access were installed and remediation of Hazeltine Creek began in 2016, which focused on providing rainbow trout (*Oncorhynchus mykiss*) spawning, and rearing habitat based on known habitat suitability characteristics. In 2018, the upper two kilometers of remediated creek were reopened to fish from an upstream lake (Polley Lake) with the primary objective of re-establishing rainbow trout spawning and rearing. Rainbow trout habitat use and recruitment success were evaluated based on the following: observations of spawning and rearing behaviour; visual counts of young-of-the-year (YOY) immediately after hatching and throughout the growing season; and number of YOY migrating from Hazeltine Creek back to Polley Lake. During the spawning period, visual surveys indicated utilization by approximately 4,800 spawning adults. By mid-summer, over 18,000 YOY had emerged from the spawning gravel and were foraging within the creek. This work documented the effectiveness of the remediated creek in providing spawning, rearing and foraging habitat for rainbow trout. (Poster)

Corchis-Scott, R.G*.; Pitcher, T.E. University of Windsor. **Genetically informed conservation breeding and reintroduction of an imperiled freshwater fish: elucidation of population structure, paternity and survival in *Erimyzon sucetta*.** Freshwater fishes are thought to be in decline across North America due to anthropic activities including habitat destruction, the introduction of invasive species, pollution, over-exploitation, and shifts in global climate patterns. Combatting or reversing the decline of at-risk freshwater fish requires the use of

captive breeding and reintroductions. Reintroduction and captive breeding are difficult to execute and should be based on knowledge of population structure and life-history traits. Both genetic population structure and paternity ratios (a key life-history trait) can be elucidated in a cost-effective manner using microsatellite analysis. *E. sucetta* is a freshwater fish that is threatened in Canada under the Species at Risk Act. Neither the genetic structure of extant populations nor paternity ratios have yet been described in this species. Here we propose the characterization of both the genetic population structure of *E. sucetta* across its range and reproductive skew within populations of this fish using microsatellite data. A better understanding of genetic diversity within and among *E. sucetta* populations and whether distinct lineages of this species exist will help conservationists select source populations for reintroduction. Additionally, knowledge of paternity ratios could be used to inform captive breeding protocols for this species. (Poster)

Crawford, S.S. University of Guelph. **An ethological analysis of expert Indigenous, Local and Science knowledge on White Shark (*Carcharodon carcharias*) mating in Aotearoa/New Zealand.** During 70+ interviews with expert Maori, Local and Science knowledge holders during 2015/16 in Aotearoa/NZ (whitepointer.cloud), numerous undocumented insights were revealed about the behavioural ecology of White Sharks (*Carcharodon carcharias*). One of the most intriguing themes emerging from first-hand and traditional (i.e. trans-generational) sources extended well beyond the spartan scientific literature on the mating system in this species. When considered from an ethological perspective, the narrative elements combine to form a new hypothesis of phased White Shark courtship and mating that begins with early migration of juvenile and mature males to seasonally-hyperproductive nearshore feeding grounds (fish/pinniped), where males establish a local dominance hierarchy. Toward the end of hierarchy formation, large reproductively-primed females arrive at the staging area and engage in preliminary mate choice from individuals in the hierarchy. Temporary male-female pairing leads to courtship behaviour (including ritualized feeding behaviour?) en route to suitable mating substrate. Courtship culminates with a brief yet intense encounter, in which the female allows ritualized mouthing, benthic rolling, clasper insertion and intromission - after which the mates immediately disperse from each other. Narrative evidence is presented for each phase of this hypothesis, along with evidence and hypotheses from the published scientific literature. (Oral)

Creed, I.F.; Enanga, E.M.*; Erratt, K.J.; Xu, Y.; Trick, C.G. Western University. **Iron and molybdenum influence growth and microcystin production of a freshwater cyanobacterium, *Microcystis aeruginosa*.** The cyanobacterium *Microcystis aeruginosa* is a freshwater bloom forming species which produces microcystin, a hepatotoxin, that contaminates drinking water supplies. Understanding environmental factors that regulate toxicity is important due to public health concerns. We investigated photosynthesis, growth, and toxin content of one toxic strain of *M. aeruginosa*, CPCC 300, under a combination of nitrogen supply, nitrate (NO_3^-) or ammonium (NH_4^+) and trace elements iron (Fe) and molybdenum (Mo). When replete Fe was supplied, *M. aeruginosa* grew equally well on NO_3^- and NH_4^+ . Reducing Fe decreased growth efficiency when cells were supplied with NO_3^- , but not NH_4^+ while removal of Mo had no effect. Cells preconditioned under a gradient of Fe concentrations without Mo were spiked with

replete levels of Mo, Fe or in combination to assess recovery. Replenishing Fe enhanced growth, photosynthesis, and toxin production. However, supplementing with both trace metals, further enhanced toxin production in cells previously grown in deplete Fe concentrations, showcasing the synergy of both trace metals. Our findings suggest, macronutrients are important for biomass accumulation but micronutrients, Fe and Mo, regulate macronutrients processing (especially NO_3^-), indirectly influencing C allocation towards biomass accumulation or excess N towards synthesis of N rich secondary metabolites like microcystin. (Oral)

Cruz-Font, L.*; Simard, J.; Isaac, B.; Cheechoo, J.; Louttit, S.; Struthers, D.; Chetkiewicz, C.; O'Connor, C. Wildlife Conservation Society Canada. **Science and Stewardship: Biomonitoring Namayo - Lake Sturgeon - In Northern Ontario.** Natural systems are facing unprecedented challenges, and successful stewardship requires the cooperative actions of multiple parties. Here, we present a collaborative approach to integrate scientific and indigenous traditional knowledge into the stewardship of namayo - lake sturgeon - in the Moose Cree First Nation traditional homeland. Our research team includes First Nation, non-profit, and academic partners, and is using physiological sampling and acoustic telemetry to understand lake sturgeon health, movement, and activity in two river systems: one intact, and one fragmented by hydropower facilities. Preliminary results indicate that fish in the fragmented river show poor body condition and altered activity compared to fish in the intact river, which supports long-standing Moose Cree concerns. Data collection is ongoing and will be incorporated into a broader Moose Cree/Ontario Power Generation monitoring program, and used to develop strategies to reduce the impact of infrastructure development and climate change on lake sturgeon. (Oral)

Dainard, P.*; Schiff, S.; Aukes, P.; Elgood, R.; St. Pierre, K.; St. Louis, V.; English, M.; Lehnerr, I. University of Waterloo. **Impact of glacial meltwater fluxes to carbon cycling dynamics in the Lake Hazen watershed of the Canadian high Arctic.** Heavily glaciated terrain of Canada's high Arctic has succumbed to widespread glacier ice cover and mass losses over the past several decades. Consequently, seasonal pulses of glacial meltwater to downgradient aquatic systems have also increased, thereby implicating hydrologic mass budgets and biogeochemical cycling. Lake Hazen is Canada's most northern large lake (75 x 12 km; max depth ~ 265 m) and is fed by seven (7) major rivers dominated by glacial runoff, making it an ideal sentinel for climate induced change to freshwater systems of the Canadian high Arctic. In this study, dissolved organic carbon (DOC) composition was assessed along glacial river transects using absorbance (a_λ , S_λ - λ , SR), fluorescence excitation emission matrix spectra (EEMS), size exclusion chromatography (SEC), and stable carbon isotopes ($\delta^{13}\text{C}$ -DOC). Dissolved inorganic carbon (DIC) concentration, pH, temperature, and pCO_2 were used to calculate theoretical $\delta^{13}\text{C}$ -DIC for a model system assuming equilibrium conditions and no additional sources of DIC for comparison with actual laboratory measured isotopic signatures. To explain departure of measured $\delta^{13}\text{C}$ -DIC from theoretical values and to assess the importance of mineral phase interactions in these systems isotopes of particulate carbon fractions ($\delta^{13}\text{C}$ -PC, PIC, and POC) were interpreted in tandem with radiocarbon ($\delta^{14}\text{C}$) signatures. (Oral)

Dallosch, M.A.*; Creed, I.F. Western University. **Old tools applied at new scales to monitor the frequency and magnitude of algal blooms.** Harmful algal blooms are on the rise globally, in which there is a demand for improved historical context and monitoring efforts. This research aims to develop tools for accurate surface chlorophyll-a (chl-a) retrieval (a proxy for algae) within inland lakes as a basis for improved scientific understanding of algal blooms. Landsat satellite images (4-5 TM, 7 ETM and 8 OLI) were used to create a ± 30 year predictive model (1984 to 2017), for the following ecoregions: polar, boreal forest, temperate forest, temperate steppe, temperate desert, subtropical humid forests, and tropical moist forests. Regression analyses for 82 algorithms were conducted to determine best fit models (linear, exponential, logarithmic, power) for chl-a and interfering signals of true water colour, total suspended solids, and turbidity to top of atmospheric reflectance. These algorithms were used to assess the usefulness of chl-a predictions within both a regional, and global context. This allows for further analysis, in which we may assess the relationship between temperature/precipitation and the rate of change in peak chl-a concentrations. This may improve our understanding of how climate change may impact regional bloom development, along with additional possible covariates. (Oral)

Davison, P.I., Créach, V., Vilizzi, L., Britton, J.R., Copp, G.H.*. Centre for Environment, Fisheries & Aquaculture Science (Cefas), UK. **Comparison of non-native freshwater fish detection efficiencies and costs using conventional and eDNA approaches to inform conservation management decisions on the deployment of monitoring resources.** Many published studies report higher detection rates from eDNA analysis than conventional methods (electrofishing, netting, trapping) for freshwater fishes, especially cryptic and rare species, with potentially lower surveying costs. To evaluate the relative costs of eDNA and conventional methods, fishes of a uniform density per hectare were stocked into a series of ponds of increasing surface area (two = 0.5 ha; two = 1 ha; one = 3.6 ha; one = 4.5 ha) in which neither species had ever been stocked or previously captured. Surrogate non-native species (a native species: barbel, *Barbus barbus*; and a “permitted” non-native species: rainbow trout, *Oncorhynchus mykiss*) were used to avoid pest species introductions. Water samples were collected prior to fish stocking and then, a week later conventional sampling was followed within hours by collection and filtering of water samples, which were cooled to frozen for laboratory analysis using a nested PCR protocol using species-specific primers to achieve the highest possible probability of determining presence/absence of the target species relative to conventional sampling. The conventional and eDNA detection results will be presented in the form of a decision-tree intended to inform the management decision process, aiding managers in the deployment of monitoring resources. (Oral)

deLeeuw, A.D.*; Robinson, B.W. Department of Integrative Biology - University of Guelph. **Experimentally testing habitat selection by phenotype matching in a natural pumpkinseed sunfish (*Lepomis gibbosus*) population.** Adaptive divergence in sympatry relies on solving the problem of random movement which breaks down genetic structure. The movement capabilities of large fishes should be a formidable barrier to adaptive divergence within single populations. Nevertheless, populations occupying heterogenous environments often result in the coexistence of multiple specialized ecotypes. Theory indicates that directed movement

through matching phenotype to habitat promotes divergence by contributing to “directed gene flow”. Two adaptive hypotheses can cause directed movement behaviour. First, is site selection where knowledge of a site enhances individual fitness and acquiring that knowledge is costly. This predicts that displaced individuals will return to their origin sites. Second, is habitat selection where individuals seek habitats that correspond to phenotype to increase feeding performance. This predicts that individuals will select sites based on their functional traits. By directing gene flow through functional phenotype matching, habitat selection should have a stronger effect on adaptive divergence than site selection. Although a moderate base of theory exists in the literature implying the importance of habitat selection, it is missing empirical support. Here, I propose a mark-transplant-recapture experiment to assess the importance of habitat selection relative to site selection in a polymorphic population of pumpkinseed sunfish (*Lepomis gibbosus*). (Oral)

Dixon, H. J.*, Harrison, G., Lister, A., and MacLatchy, D. Biology Department, Wilfrid Laurier University. **Reproductive status of walleye (*Sander vitreus*) and lake whitefish (*Coregonus clupeaformis*) in two large, shallow subarctic lakes.** Tathlina and Kakisa Lakes are large, shallow lakes in the Dehcho region of the southern Northwest Territories, supporting commercial and subsistence fisheries for walleye (*Sander vitreus*) and lake whitefish (*Coregonus clupeaformis*) for the nearby Ka’a’gee Tu First Nation. While these two fish populations are of significant economic importance to the local community, and the shallowness and northern latitude of these lakes puts them at increased risk from climate change, little is known about the reproductive status of these species. Fish were sampled in both lakes across multiple years in the spring and autumn to assess differences in reproductive status in the pre- and post-spawning periods for both species. Condition factor, gonadosomatic index and liversomatic index were calculated for each fish, and fecundity was also calculated for females captured in Tathlina Lake. Plasma samples were also taken from each fish to determine levels of reproductive hormones, specifically 17α -estradiol in females, and 11-ketotestosterone in males. Significant temporal (intra- and interannual) and spatial (between lakes) variation was found for both species and for both sexes for all metrics. The data in this study can be used and expanded upon to provide information for the sustainable management of these fish stocks for the future. (Oral)

Dixon, H.J.*, Brekke, L., and Swanson, H.K. Biology Department, Wilfrid Laurier University. **Using Broad Scale Monitoring (BSM) methods to assess the fish community of a small sub-Arctic lake.** Sanguex Lake is a small, riverine lake in the Dehcho region of the southern Northwest Territories, utilised for subsistence fishing by the Jean Marie River First Nation. Previous sampling of this lake revealed high levels of mercury in some species of fish, particularly northern pike (*Esox lucius*). In an attempt to assess the status of the fish community in Sanguex Lake, the Broad-Scale Fish Community Monitoring (BSM) protocol was utilised for the first time in the Dehcho region. Large- and small- multimesh gillnets were set over four depth strata in the lake in May 2018. Northern pike, cisco (*Coregonus artedii*), lake whitefish (*Coregonus clupeaformis*), and walleye (*Sander vitreus*) were captured during this monitoring programme. Fishing was most successful in the 1-3 m depth strata, and least successful in the 12-20 depth strata, with the large mesh nets catching more fish than the small mesh nets. Northern pike

was the most numerous species sampled, while walleye was the least. Use of the BSM protocol in this small, remote, northern lake, while largely successful, was found to be constrained by a number of factors, including the width of the depth strata, and the temperature of the lake. (Poster)

Dodsworth, W.P.*; Pick, F.R. University of Ottawa. **Temporal trends in cyanobacteria in Central Ontario lakes through paleo-DNA analyses.** With increasing levels of human activity and the effects of climate change, lakes are experiencing conditions favoring cyanobacterial dominance. High cyanobacterial densities can lead to blooms or surface scums and potentially the production of toxins that can affect wildlife and humans alike. However, the significance of factors, such as climate change and nutrient loading are unclear due to incomplete historical records. To address this, paleolimnological techniques based on sediment DNA analyses can be used to supplement historical data. Sediment cores were collected from paired lakes in Central Ontario. sedDNA was extracted from sediment core sections to quantify trends in total bacterial abundance (glnA), cyanobacterial abundance (16s rRNA) and microcystin toxin sub-unit (mcyE) related genes through ddPCR amplification techniques. We will also assess the effect of lake morphology on DNA preservation using cores harvested at various depths and bays of a single lake. The degree of preservation with depth will be assessed by amplifying a long vs. short primer of a single target gene. Through this, we aim to further validate the use of advanced quantitative genetic methods in analyzing environmental change as well as helping to identify lake types and sites with sufficient sediment DNA preservation. (Poster)

Donadt, C.R.*; Graydon, J., Cooke, C., Poesch, M. University of Alberta. **Is the Red Deer River a mercury bioaccumulation hotspot? A comparison of mercury levels in fish from various rivers in Alberta.** The Red Deer River (RDR), Alberta is a popular angling destination, but recent studies indicate mercury levels in the water often surpass surface water quality guidelines (chronic = 5 ngL⁻¹, acute = 13 ngL⁻¹). High ambient mercury levels are a concern, as this contaminant is known to bioaccumulate to concentrations in fish far exceeding ambient levels. In this study, we examine if mercury concentrations of fish from the RDR are also elevated, indicating a “hotspot” of mercury contamination in Alberta. To determine fish mercury concentrations, total mercury was analyzed in muscle tissue of 376 fish collected from 2014 to 2017. The results show fish mercury concentrations range from 0.03 to 2.12 mg/kg (median = 0.46 mg/kg) and exceed Alberta recommended fish consumption limits (0.5 mg/kg) in 46% of sampled fish. When compared to data collected by the Government of Alberta, raw mercury levels in some fish from the RDR are the highest recorded in Alberta. A comparison of length-standardized fish mercury concentrations is currently being undertaken to facilitate comparison among watersheds. The results of this study will be important for informing fish consumption advisories in the Red Deer River, and understanding spatial patterns of fish mercury levels in Alberta. (Oral)

Dulal-Whiteway, C.D.W.*; Rooney, N.; Turetsky M. Canada. **Investigating the biogeochemistry and metabolism of agriculturally impacted streams in Southwestern Ontario.** Excessive phosphorus inputs from agricultural areas has been identified as one of the main culprits behind the eutrophication problem in Lake Erie and its major tributaries. Research aimed at

improving water quality is crucial to combat this problem and maintain the ecosystem services and biodiversity within these waterways. My research focuses on the effects of agricultural activity on the biogeochemistry and metabolism of streams within the north shore of the Lake Erie watershed. Few studies have examined the coupling of carbon and phosphorus cycles and the relationship between these cycles and ecosystem metabolism within agricultural streams. I aim to address these gaps by assessing spatiotemporal trends between land use and carbon and phosphorus ratios in streams within Southwestern Ontario. Then, I will examine the relationship between carbon and phosphorus ratios and metabolism within these streams. Finally, I will determine if the addition of carbon can increase microbial metabolism and phosphorus retention in these streams. This study will improve our understanding of the links between the carbon and phosphorus cycles, and the impact of agriculture on these linkages. It will improve management strategies by exploring the resilience of streams and the possibility of re-balancing the stoichiometry of streams impacted by agriculture. (Poster)

Dunlop, E.S.*, Goto, D., Jackson, D. Ontario Ministry of Natural Resources and Forestry, Trent University. **Are we fishing down the food web in Lake Simcoe?**. Declines in mean trophic level of fisheries catches over time has been attributed to “fishing down the food web”. This pattern has been observed in commercial marine fisheries when larger, piscivorous species are first depleted and catches shift to species closer to the base of the food web. Previous work has shown a lack of such patterns in inland lakes, perhaps because time series are shorter or because of the legacy of stocking or invasive species. In this study, we make use of catch records from Lake Simcoe dating back to the 1860s, to examine if indicators reveal fishing down effects. We compared trends between a historical period dominated by commercial fishing, and a contemporary period when commercial fishing ceased and emphasis on recreational fishing increased. We found a striking difference between the two time periods, with the mean trophic level (MTL) declining during commercial fishing and increasing during recreational fishing. Furthermore, indicator responses were affected in a directed way by the presence of invasive species and stocking. Although the interpretation of catch-based indicators is challenging, our long time series provides a rare glimpse at the dynamic nature and extensive history of fisheries exploitation in an inland lake. (Oral)

Eickmeyer, D.C.*; Thienpont, J.R., Blais, J.M. University of Ottawa, Canada. **Impact of increased thermokarst activity on Polycyclic Aromatic Compound (PAC) accumulation in sediment of lakes in the hydrocarbon-rich uplands adjacent to the Mackenzie Delta, NT, Canada.** In ecologically sensitive, hydrocarbon-rich regions like the western Canadian Arctic, environmental monitoring of oil and gas development often focuses on both direct and unintentional consequences of increased exploration and extraction of hydrocarbon resources. However, proper assessments of impact from these activities could be confounded by natural petrogenic sources in permafrost-rich regions where increased thermokarst activity results in permafrost exposure and erosion of hydrocarbon-rich deposits. Using a paired-lake design in the tundra uplands adjacent to the Mackenzie Delta, NT, we examined 4 lakes with retrogressive thaw slump scars along their shores and 4 undisturbed reference lakes. Total organic carbon normalized concentrations of polycyclic aromatic compounds (PACs) were higher in surface sediments of slump-affected lakes than reference lakes. Diagnostic ratios of specific PACs

suggested sediment of slump-affected lakes had greater influence from petroleum-based sources than reference counterparts. This was corroborated by a principal component analysis of metals in the sediment. Slump-affected lakes were enriched in metals related to shale-based, Quaternary deposits of the Mackenzie Basin compared to reference lakes. These findings demonstrate that, to avoid misinterpreting the scale and nature of hydrocarbon development impacts to northern landscapes, monitoring of sediment PACs must be assessed in the framework of these dynamic freshwater systems. (Oral)

Ellenor, J.*, Portt, C.B., Swanson, H.K. University of Waterloo. **Variation in Slimy Sculpin (*Cottus cognatus*) condition and growth rate in six Barrenland lakes in central Nunavut.** Northern aquatic ecosystems are facing increased pressures from both industrial development and climate change, yet effective environmental monitoring of these systems remains a challenge. The high costs associated with northern monitoring programs, along with a short field season and low fish abundance, mean that sound study designs are essential. Slimy Sculpin (*Cottus cognatus*) has been identified as a sentinel species for environmental effects monitoring programs in northern Canadian lakes due to its relatively high abundance, broad distribution, and small home range. As part of a broader study to assess the effects of proposed mining development, baseline shoreline electrofishing was conducted, targeting Slimy Sculpin in six lakes in a Barrenland region of central Nunavut. Preliminary results suggest natural differences in growth rate among the lakes. Condition and growth rates of Slimy Sculpin in each of the six populations will be presented, along with biotic and abiotic factors that may account for the observed variation. Understanding natural drivers of variation in productivity of fish populations is critical to establishing effective monitoring endpoints in northern aquatic ecosystems. (Poster)

Elvidge, C.K.*; Lemopoulos, A.; Hyvärinen, P.; Vornanen, M.; Vainikka, A. University of Eastern Finland, Finland. **Providence revisited: The overlooked role of provenance in shaping life histories of brown trout (*Salmo trutta*).** Earlier studies have identified environmental factors (providence) as driving the expression of migratory behaviour in brown trout (*Salmo trutta*) populations: larger fish, fish recently deprived of food, and fish from higher-order river sections typically undergo smoltification and become migratory. Using individually PIT-tagged, captive-reared brown trout from 1) an adfluvial hatchery-bred lineage, 2) wild-caught, resident parents, and 3) their hybrids, we conducted a two-year captive migration study in circular stream channels (when the offspring were 2+ and again when they were 3+ years-old) equipped with stationary PIT antennae. Half of the fish were introduced to the stream channels in Autumn 2015 and again immediately following capture for measurements in June 2016, and left to feed on natural food (food-deprived). The other half were introduced in early Spring 2016 and again in 2017 following overwinter feeding under the hatchery regime (food-augmented). Feeding background had a weak influence on total downstream distances moved, with better-fed fish moving farther on average. However, strain (provenance) was the main factor influencing distance, with adfluvial trout moving farther than residents and hybrids demonstrating an intermediate phenotype. We found no sex differences between the pure strains, while size and physiological smolt characteristics were positively related to distance. (Oral)

Enright, D.T.*, Gillis, D.M. University of Manitoba. **Examining the presence of the ideal free distribution across regulatory boundaries in a groundfish fishery.** The ideal free distribution (IFD) from foraging theory has been successfully applied to commercial fishing using isodars that predict vessel distribution. The IFD assumes that individuals are free to move among foraging sites but fisheries management typically restricts such movement. Fish are not restricted by the artificial boundaries that limit fishing effort and potentially affect stock assessments based on observed catch per unit effort (CPUE). We examined commercial fishing in the groundfish fishery of southern Nova Scotia, Northwest Atlantic Fisheries Organization (NAFO) divisions 4X and 5Z, for evidence of IFD effort dynamics within and between these divisions. Preliminary data exploration revealed that 82% of vessels fished close to the boundary between these divisions and 70% of the vessels examined fished in both divisions. The application of isodars can reveal if effort movements could cause correlated CPUE between these divisions and if fish movement around the boundary impacts observed CPUE within them. When present, these correlations can bias CPUE series and misrepresent local abundance trends. Future stock assessments will be more accurate when accounting for the potential misrepresentation of abundance as a result of these correlations. (Oral)

Ewins, C.*; Filazzola, A.*; Mahdiyan, O.; Shuvo, A.; Sadid, T.; Moslenko, L.; Sharma, S. York University. **Getting your phyll of data: Assembling a freshwater lake water chemistry database.** Measures of chlorophyll in freshwater lakes can be used as a proxy for primary production and an indicator of water quality. However, the concentration of chlorophyll in lakes is dependent on many interacting factors including spatial heterogeneity in nutrients, climate drivers, and anthropogenic disturbance. Water chemistry sampling protocols frequently include measures of chlorophyll, and these data are readily available in published manuscripts and online repositories. Thus, we have capitalized on the opportunity to synthesize a global database on lake water chemistry with a focus on chlorophyll for freshwater lakes around the globe. We are conducting a systematic review examining over 4000 published manuscripts that measured lake chlorophyll and supplementing the published manuscripts with data available from online repositories, such as KnB, Dryad, and Pangaea. To date, we have developed a database of geographic, morphology, and water chemistry for over 2,200 lakes in 45 countries across 7 continents. Using the geospatial coordinates of the lakes, we can relate measures of chlorophyll to climate drivers, anthropogenic disturbances, and land use changes across broad spatial and temporal scales. This database will facilitate future research to improve our understanding of how water quality responds to global environmental change. (Poster)

Favot, E.J.*; Hadley, K.R.; Michelutti, N.; Paterson, A.M.; Smol, J.P. Queen's University. **Estimating historical changes in cyanobacterial production from lake sediments using Visible Near-infrared Reflectance Spectroscopy (VNIRS).** Cyanobacterial blooms are a pervasive and escalating environmental issue globally, with important consequences for potable water resources, the recreational economy, water-front property values, and ecosystem health. However, there is a lack of available long-term monitoring data to provide ecological context and to determine the drivers of the increasing frequency and severity of cyanobacterial blooms reported in the last few decades. Here, we summarize our work developing a paleolimnological model to infer historical changes in colonial cyanobacterial production using visible and near-

infrared reflectance spectroscopy (VNIRS) on lake sediments. A dilution series of sediment matrix inoculated with increasing amounts of mixed cyanobacterial culture was established, and partial least squares regression models were developed to correlate spectral signatures (including distinct peaks at 416-516 nm and 588-642 nm) to HPLC-determined concentrations of myxozanthophyll, zeaxanthin, and parts per thousand of cyanobacteria additions. Applications of the resulting models to three northwestern Ontario lakes yielded downcore trends that were comparable with conclusions from HPLC. This application of VNIRS to detect cyanobacterial photosynthetic pigments in lake sediments is the first of its kind and has the potential to be an important tool for lake management because it is rapid, relatively inexpensive and non-destructive. (Oral)

Fernandes, T.*; McMeans B. University of Toronto Mississauga. **A tale of two strategies: Investigating how freshwater fish thrive in seasonal climates.** The suite of selective pressures associated with seasonality has been shaping the ecology and physiology of temperate and polar organisms for millennia. Subtle changes in the seasonal pattern of climatic variations can have drastic downstream impacts on the phenology of both terrestrial and aquatic organisms. Such impacts may be difficult to quantify through behavioural observation or population monitoring. In this study, we have combined protein, triglyceride, diet, and neural data from telemetered populations of cold- and warm-water predators (Lake Trout [*Salvelinus namaycush*] and Smallmouth Bass [*Micropterus dolomieu*] respectively) to better understand seasonal adaptation across thermal guilds. Sampling at Lake of Two Rivers, Algonquin Park occurred in every season for a full year cycle (Spring, Summer, Fall, Winter, Spring). Continuous, 3-Dimensional telemetry data was collected for each species during the same time period. The integrative nature of this dataset has allowed us to conduct novel comparisons between fish species with thought-to-be distinct seasonal strategies. We have also conducted a comprehensive review of seasonal lipid storage patterns in temperate fishes. Our results will help to better inform sustainable fisheries management practices, while also building on prior field and laboratory studies. (Oral)

Finerty, C.J*. Heath, D.D., Warriner, T.R., Semeniuk C.A.D., Love, O.P. University of Windsor. **Applying transcriptomics to the interactive effects of thermal and pre-natal stress on developmental plasticity in juvenile chinook salmon.** Freshwater bodies are experiencing large thermal variability compounded with increased temperature means. Ectothermic fish are particularly sensitive to these changes since their body temperatures are linked to the external environment. We lack mechanistic information on whether these species can rapidly respond to thermal change. Since chronic and acute thermal stressors illicit a glucocorticoid (GC) stress response, and elevated egg GCs affect offspring developmental plasticity, they have been proposed as a signal of future environmental quality. I will examine transcriptional plasticity in Chinook salmon using candidate genes associated with metabolism, growth, immunity, and stress (response to chronic thermal stress of +3°C above current), and whether exposure to prenatal stress buffers these responses. Eggs received an environmentally-relevant cortisol dose and were incubated under the thermal or control temperatures. We collected whole fish at the eyed-egg, alevin, and fry stages to quantify transcriptional variation using an Openarray approach. In a second experiment, parr stage fish underwent a thermal stressor (pulses of +9°C

for three days) to examine their transcriptional ability to respond to an acute thermal stressor. Overall, we aim to identify phenotypes associated with greater performance and survival to improve the reintroduction and stocking of fish species in thermally stressed systems. (Oral)

Finlay, K*; Webb, J.R.; Wissel, B.; Leavitt, P.R.; Baulch, H.M.; Simpson, G.L.; Haig, H.A; Hodder, K.R. University of Regina. **Landscape-scale drivers of nutrient concentrations in natural and artificial water bodies of the Northern Great Plains.** Water bodies in dry and productive regions often experience poor water quality because of evapo-concentration of solutes and high catchment loading rates. In the semi-arid agricultural region of the northern Great Plains, lakes and reservoirs are particularly sensitive to variation in water balance (evaporation to inflow ratios; E:I), catchment soil, and land-use. Spatio-temporal variation in climatic effects thus poses a significant challenge for management adaptation to future atmospheric warming. Here, we used hydrological estimates of E:I, as well as GIS estimates of drainage basin soil characteristics and land-use, to determine the relative influence of contrasting landscape-scale processes on N and P concentrations in 103 natural lakes, and 100 agricultural reservoirs over ~240,000 km². Overall, higher E:I ratios were correlated with higher concentrations of both N and P in both lakes and reservoirs. Nutrient concentrations in natural lakes were higher in catchments dominated by grassland, and further increased with hydraulic conductivity. In contrast, land-use and soil characteristics did not predict variation in nutrient content of farm reservoirs, although deeper water bodies exhibited lower nutrient concentrations. Thus, management for water quality of agricultural reservoirs may need to focus on basin morphology, while natural lakes may benefit from improved management of landscape features. (Oral)

Fox, M.G.*. School of Environment and Department of Biology, Trent University. **Historical changes in thermal regime and its influence on abundance and community structure of Kawartha Lakes piscivore communities.** Changes in the piscivore community of four large lakes in the Kawartha region of Ontario were examined using fisheries assessment data over a 35 year period (1980-2015), and relating catches to trends in temperature, turbidity and total phosphorus concentration. Over this period, mean summer temperature increased by an average of 0.5° annually. Both turbidity and total phosphorus concentration decreased significantly over time in three of the lakes. Mean CPUE of walleye in trapnets showed a declining temporal trend in all of the lakes. In contrast, three lakes showed a significant increase in largemouth or smallmouth bass CPUE over time. As a result, piscivore community composition changed, with a regional-scale decline in the abundance of walleye relative to that of warmwater bass species. The increase in air temperature over time was strongly associated with a decrease in relative walleye abundance in three of the lakes. These data suggest that climate warming, in combination with regional declines in turbidity and nutrient concentration are affecting the makeup of the fish community in the Kawartha Lakes by favouring bass over walleye. (Oral)

Gallage, K. S. *, Mandrak, N. E., Lovejoy, N. R., Lujan, N. K. University of Toronto, EEB Department, Canada and University of Toronto Scarborough Campus, Biology Department. **Metagenomic approach to identify and quantify juvenile fish and eggs from the Great Lakes**

Basin. The ability to accurately detect and estimate the abundance of at-risk and aquatic invasive species is critical for management these populations. Current methods to identify and quantify fish populations are costly, particularly egg and juvenile life-stages. Molecular approaches to identifying species at egg and juvenile life stages may be more cost-effective and more accurate than the existing morphological approaches. The purpose of our study is to develop an universal molecular tool to identify a wide variety of fish species across the Great Lakes and its tributaries. We've created a set of primers targeting the COI gene sequence of approximately 148 species with emphasis on at-risk species- and invasive fish species. Currently, our set of primers are able to amplify 80% of the species tested, and our sequencing data has resulted in greater than 98% match-identification. Our tool will be used to identify and quantify ~1300 samples of unidentified juveniles and eggs collected from Great Lakes sites thought to contain at-risk and invasive fishes. If successful, this method will effectively reduce the time required for fish identification, reduce the number of misidentifications, and increase early detection of aquatic invasive species. (Poster)

Gallant, L.R.*; Kimpe, L.E.; Eickmeyer, D.C.; Blais, J.M. University of Ottawa. **Reconstructing cultural eutrophication in lake sediments using sterols.** Cultural eutrophication can have significant impacts on lakes, particularly those in the high Arctic. One such cause of cultural eutrophication can result from the dumping of sewage waste into high Arctic ponds. For example, in Resolute Bay, sewage from an air base was deposited into several high Arctic lakes from 1949 to 1998. Previous studies showed a change in the nutrient composition and diatom assemblages of these lake sediments. Notably, these changes could arise from a number of factors, and consequently, we set out to use a more specific marker of human waste to unequivocally link sewage dumping to the alteration of these lakes. In 2017, we took lake sediment cores from four sewage-influenced lakes and one reference lake in Resolute Bay. We examined many sterols, some associated with human activity and others associated with vegetation growth. Coprostanol, (indicative of human waste), increases in lake sediments coeval with increases in $\delta^{15}\text{N}$, while algal-derived sterols, such as sitosterol, are more abundant in pre-influenced lake sediments. This is a proof of principle study showing the effectiveness of using sterols to reconstruct historical waste deposition; this methodology may also play a critical role in examining human occupation at archaeological sites. (Oral)

Gillis, D.P.*; Minns, C.K. University of Toronto. **Regional application of a seasonal temperature-profile model to estimate fish thermal habitat supply.** Temperature is a key characteristic of aquatic systems with profound impacts on their biota. Reliable, regionally applicable lake temperature models are necessary to address the needs of environmental assessments. Modeling lake temperature is a suitable approach to assessing fish thermal habitat supply, which is constrained by lake temperature regimes. Some models require extensive local data; however, sampling the temperature of numerous lakes throughout the year may not be economically or logistically feasible. In this study, we will test a semi-mechanistic seasonal temperature-profile model (STM) on dimictic lake temperature datasets across North America to assess the model's predictive capabilities across highly variable geographic regions. Through the application of multivariate statistical modelling, we will build a set of sub-models to predict the STM's parameters based on readily available environmental data (e.g. climate, latitude, lake

morphometry, and water quality parameters) to extend the STM's applicability to lakes lacking temperature data. Based on these findings, we can explore how fish community patterns vary with thermal habitat availability under current and future climatic scenarios. Further, this research will inform water temperature sampling programs by providing indices of when, where, and how often sampling should be done to enhance model performance. (Poster)

Gislason, D.*; McLaughlin, RM.*; Robinson, BW*. Department of Integrative Biology, University of Guelph. **Drivers of temporal life history variation in Lake Erie's harvested yellow perch.** The development of fisheries science in Canada benefitted from behavioural perspectives documented by Miles Keenleyside's 1996 CCFR presentation (CJFAS 54: 2709-2719). A clear recognition of the effects of individual decisions on Darwinian fitness, and the expectation that traits often will vary adaptively among populations and under different ecological conditions, underpinned these perspectives. Behaviour influences survival and reproductive success in many ways, including alteration of the energy available to an organism for growth, survival, and reproduction. Due to his academic upbringing, Keenleyside recognized that behaviour and life history are linked through causal pathways that operate in both directions and several of his writings noted how behavioural decisions could influence life history traits of fishes. Behavioural perspectives that recognized the fitness consequences of individual decisions lent themselves to the development and integration of life history perspectives in fisheries science. We assess the importance that harvest and physical ecosystem drivers have on temporal variation in the maturation of four Lake Erie fishes. Contemporary harvest appears to have much less of an effect than ecosystem processes relating to climate. Our assessment demonstrates how understanding the individual maturation responses to environmental conditions can inform life history research and the management of harvested stocks (Oral)

Glaser, D.M.*; Post, J.R. University of Calgary. **Density-dependent growth of brook trout in pristine and over-harvested systems.** Decreased density of fish via harvest may trigger compensatory responses such as increased growth, fecundity, and survival. Understanding the magnitude and interactions among compensatory processes are crucial to inform resource management. Here we present age and growth data of introduced Brook Trout (*Salvelinus fontinalis*) from lakes in the Canadian Rockies. We measured initial population demographics and then experimentally harvested approximately 50% of adult fish. Pre-manipulation, lakes exhibited different growth rates and densities. We explore whether elevation and population density are likely the best predictors of growth rates. After experimental manipulation of trout densities, we hypothesize that growth rates will increase relative to the control lakes. Such experiments in undisturbed systems allow us to test hypotheses about density dependent processes, which in turn better informs our collective understanding of how fish stocks respond to harvest. (Oral)

Gobin, J.*, Fox, M.G., Lester, N.P., Dunlop, E.S. Trent University. **How ecological and evolutionary change affect maturation reaction norm estimates.** Probabilistic maturation reaction norms (PMRNs) are commonly used to infer evolution of maturation age and size in wild fish stocks, because they account for growth-mediated changes in maturation. Yet, how well PMRNs distinguish evolutionary change in maturation from that arising due to variable

growth under different ecological conditions has never been tested. We used an individual-based eco-genetic model to simulate populations undergoing various levels of fisheries-induced evolution and ecological feedbacks, to evaluate their effects on the estimation of PMRNs. We sampled these simulated populations and estimated PMRNs from phenotypic data (the age, length, and maturation status of individuals) as would be done for a wild population and compared these with the known maturation genotypes of individuals in the model. Individuals in the model matured earliest when PMRNs evolved in response to harvest and growth was density-dependent. PMRN estimates were generally robust to changes in density-dependent growth and high levels of fisheries-induced evolution. However, slower rates of evolution were harder to detect, especially when maturation occurred over a narrow age range. This study suggests that this widely applied method is robust to key factors that can vary in wild populations, while highlighting considerations for inferring evolutionary change from phenotypic data. (Poster)

Gobin, J.*, Lester, N.P., Fox, M.G., Dunlop, E.S. Trent University. **Ecological change alters the evolutionary response to harvest in a freshwater fish.** Harvesting can induce rapid evolution in animal populations, yet the role of ecological change in buffering or enhancing that response is poorly understood. Our study focused on lake whitefish in the Laurentian Great Lakes, where the species supports valuable commercial and subsistence fisheries, and where the invasion of dreissenid mussels caused drastic shifts in ecosystem productivity. Using an eco-genetic model, we predicted faster rates of evolution of maturation reaction norms in lake whitefish under pre-invasion ecosystem conditions when growth and recruitment of young to the population were high. Slower growth rates that occurred under post-invasion conditions delayed when fish became vulnerable to the fishery, thus decreasing selection pressure and lessening the evolutionary response to harvest. Fishing with gill nets and traps nets generally selected for early maturation at small sizes, except when fishing at low levels with small mesh gill nets under pre-invasion conditions when evolution of delayed maturation was predicted. Overall, the invasion of dreissenid mussels lessened the evolutionary response to harvest, while also reducing the productivity and commercial yield potential of the stock. These results demonstrate how ecological conditions shape evolutionary outcomes and how invasive species can have a direct effect on evolutionary responses to harvest and sustainability. (Oral)

Godin, J.-G.J.*. Carleton University. **Relative sexual attractiveness and social associations among males in a fission-fusion fish society.** Recent social theory predicts that males should choose social environments that maximize their relative attractiveness to females by preferentially associating with less attractive rivals, so as to enhance their mating success. Using the Trinidadian guppy (*Poecilia reticulata*), a highly social species, we tested for non-random social associations among males in mixed-sex groups based on two phenotypic traits (body length and coloration) that predict relative sexual attractiveness to females and sexual (sperm) competitiveness. Based on a laboratory dichotomous-choice test of social group preference, we could not reject the null hypothesis that focal males chose randomly between a mixed-sex group that comprised a female and a rival male that was less sexually attractive than themselves and another mixed-sex group containing a sexually more attractive male. The same conclusion was reached when females were absent from the two groups. As might be expected

from these laboratory findings, free-ranging males in the field were not assorted by either body length or colour in mixed-sex shoals. The apparent lack of an expressed preference in wild male guppies from our study population to form non-random social associations with other males is likely due to the fission-fusion dynamics of guppy shoals in nature, which is described here. (Oral)

Goldman, J.A.*; Feyten, L.E.A; Demers, E.E.M; Désormeaux, I.S.; Ramnarine, I.; Brown, G.E. Concordia University. **Prior experience shapes the response of Trinidadian guppies to disturbance cues: evidence from laboratory and field studies.** Chemosensory cues are commonly used by aquatic prey species to assess local predation risk. Disturbance cues, common among aquatic vertebrates, are argued to function as early-warning signals and are released by stressed or disturbed individuals. These cues may supply preliminary information alerting conspecific and heterospecific prey-guild members of potential risk. Recent evidence from amphibians suggests that, akin to damaged-released alarm cues, prior experience with risk alters how individuals release and respond to disturbance cues. We tested the hypothesis that prior experience with predation risk will alter how prey fish release and respond to disturbance cues using both wild and laboratory populations of Trinidadian guppies *Poecilia reticulata*. Initially, we demonstrate under natural conditions that guppies respond to disturbance cues and their response is influenced by the level of risk experience by a population. Secondly, using wild caught guppies in the laboratory, we found that individuals scaled their responses according to their combined experience (donor x receiver). Finally, using laboratory guppies from the same population, we show that the scaled responses to disturbance cues based on prior experience are inducible, and not the result of population differences. These data highlight the complexity of risk assessment within aquatic communities. (Poster)

Goudie, M.T.*; Stitt, B.C.; Humphries, S. Parks Canada Agency. **Rotenone: dusting off a useful management tool in the Mountain National Parks.** Historic stocking practices in the mountain national parks saw the widespread introduction of non-native fish including, but not limited to, brook (*Salvelinus fontinalis*), rainbow (*Oncorhynchus mykiss*), and Yellowstone cutthroat trout (*Oncorhynchus clarkii bouvieri*). We now know that these non-native fish are able to competitively exclude or hybridize with native fish and these interactions are understood to be key threats or limitations to recovery for westslope cutthroat trout (WSCT; *Oncorhynchus clarkii lewisi*). Westslope cutthroat trout are listed as Threatened in Alberta and Special Concern in British Columbia. In spite of zero harvest and moderate angler pressure, this species continues to decline in abundance, distribution and genetic integrity. The population of WSCT inhabiting Hidden Lake and upper Corral Creek in Banff National Park has been extirpated by stocked brook trout. WSCT recovery efforts to remove brook trout began in 2011 utilizing physical removal methods. Mechanical efforts continued until 2017 when it was decided that a more efficient and effective alternative method was required. Parks Canada Agency investigated the feasibility of using rotenone based fish toxicants by undertaking training and assisting with neighbouring government agencies. It was determined that the use of rotenone was an efficient and effective management tool. (Poster)

Grant, J.W.A. Concordia University. **Space use in stream fishes.** Miles Keenleyside is perhaps best known as the Father of Fish Behaviour in Canada, having spent most of his career as a Professor at the University of Western Ontario. After completing his PhD in Holland, however, his first position was as a Research Scientist for the Fisheries Research Board of Canada in St. Andrews, NB, where he completed pioneering work on salmonid behaviour and ecology. In particular, he published two highly influential papers on salmonid territoriality, which taken together with Kalleberg (1958), set the stage for the field of salmonid behavioural ecology as we know it today. Like other European-trained ethologists, Keenleyside brought his enthusiasm for the study of animal behaviour back to North America. In this talk, I will explore how fish behaviour was slowly integrated into fisheries biology, and now is completely integrated into our understanding of space use, movement and population regulation of stream fishes, particularly salmonids. (Oral)

Grove, C.M.*, Roloson, S.D., Pavey, S.A., van den Heuvel, M.R. Canadian Rivers Institute and University of Prince Edward Island. **Population genomics of Atlantic salmon (*Salmo salar*) and its implications on Prince Edward Island.** Atlantic salmon are a species of concern worldwide; therefore, it is important to understand their genetic diversity and the fitness implications of that diversity. A unique genotype of Atlantic salmon within the Gulf of St. Lawrence was recently identified at two locations on Prince Edward Island (PEI), Canada. This may represent the original genetics on PEI prior to extensive stocking from other locations within the Gulf. In order to characterize the full geographic extent of this genotype, microsatellites were used in order to analyse all twenty Atlantic salmon stream populations on PEI. Fin clips were taken from juvenile salmon and DNA extracted using a chelex-based method. Illumina tagged primers were used in a fifteen loci multiplex PCR. A second PCR will be performed in order to add a 6b barcode to differentiate between individual fish and populations. Genetic analysis was combined with a study of the reproductive movements of adult salmon using PIT tags in one of the rivers known to contain this unique genetic stock. Adult salmon tagged and monitored using five antenna arrays in North Lake, plus two arrays in adjacent watersheds. Although, straying between adjacent streams did not occur, a lot of movement within North Lake was evident. (Poster)

Guernon, S.*, Swanson, H., and A.M. Derry. Université du Québec à Montréal. **The role of dissolved organic carbon and zooplankton community composition on methyl mercury bioaccumulation in Western Arctic lakes.** The transfer of methylmercury (MeHg) at the base of aquatic food webs to higher trophic levels is poorly understood. The role of dissolved organic carbon (DOC) gradients on MeHg bioaccumulation in zooplankton is unknown despite that climate change is predicted to increase DOC in boreal and arctic lakes. We predicted, 1) zooplankton MeHg bioaccumulation would follow a unimodal relationship along a DOC gradient among arctic lakes, and 2) zooplankton communities dominated by passive filter feeders, such as cladocera, should have higher MeHg compared to selectively-feeding copepods. We collected zooplankton from 11 western Arctic lakes along a DOC gradient that spanned three regions. We found support for a unimodal relationship between DOC and MeHg bioaccumulation in zooplankton, with a peak threshold of 8 mg C L^{-1} . However, the amplitude and strength of the relationship was influenced by the dominance of zooplankton taxa in the

communities. While MeHg tissue content of bulk communities was determined by water sulphate concentrations, taxon-specific groups of cladocerans and copepods were determined by pH and DOC, respectively. Our results underlines the complexity of managing lakes for MeHg bioaccumulation in food webs across landscape gradients and in face of climate change. (Poster)

Gushulak, C.A.C., and Cumming, B.F. Queen's University. **Diatom community assemblages are controlled by light availability in deep, low-DOC lakes in northeastern Ontario.** Diatoms are found in all areas of a lake, inhabiting both the water column and the sediment surface. They are not cosmopolitan, however; it has been shown that diatom floras within lakes consistently separate into three distinct community assemblages that are associated with lake depth (near-shore benthic; deeper, lower-light benthic; and planktonic assemblages). The causative factors associated with these community splits, particularly the benthic-planktonic boundary (B:P), are not well-known due to the co-variation of potentially important factors. For example, in high-DOC or shallow lakes, the mixing depth, thermocline, and ~1% light availability can appear in close proximity to each other and the B:P boundary. To separate these depths, we examined the diatom communities from surface-sediments collected in lake-depth transects from two deep, clear (Secchi depths ~10-12 m), low-DOC lakes in northeastern Ontario. CONISS analysis on diatom assemblages revealed the previously described community zones, but with the B:P boundary at depths far below that of the thermocline and generally associated with our estimate of 1% light penetration. This suggests that diatom communities are primarily organized by light availability and the occurrence of assemblage division at thermocline depth in other lakes is due to light limitation by high levels of DOC. (Oral)

Guzzo, M*; van Leeuwen, T; Norin, T; Metcalfe, N; McCann, K; Killen, S. University of Guelph. **Interactions among metabolism, growth, and behaviour in fish exposed to thermal variability.** Climate change is expected to not only increase mean temperatures, but also result in greater thermal variation and maxima. The physiological and behavioural responses of fish to warming are often tested using average conditions, but changes associated with acclimation to stable temperatures differ from those in thermally variable environments. We performed an experiment where we tested how the aerobic metabolic rates, growth, and behaviour of juvenile brown trout (*Salmo-trutta*) respond to exposure to varying levels of daily thermal variation and maximal temperatures. The lengths, weights, and standard and maximal metabolic rates of each fish were measured at the start and end of the experiment. Following the initial measurements, fish (n=48) were size-matched, elastomer tagged, and placed in groups of four into one of three experimental treatments. Fish were exposed for one month to either natural daily temperature variation (min = 13.5°C, max = 15.0°C) or one of two treatment levels simulating increases in maximum daily temperatures of $\hat{\Delta}^{\circ}3^{\circ}\text{C}$ and $\hat{\Delta}^{\circ}5^{\circ}\text{C}$. Here, we will outline how growth rates, dominance hierarchies, and metabolic rates differed among treatments and test if individual level differences in metabolic rates played a role in determining an individual's response to increased thermal variability. (Oral)

Hancock, H.* , Kanavillil, N., Rennie, M., Doka, S. Lakehead University, Canada and Fisheries and Oceans. **Habitat associations of fishes in the Kivalliq region of Nunavut, Canada.** The Canadian

Arctic and Subarctic (north of 60 latitude) support unique aquatic environments governed by the natural geomorphology of rivers and lakes. Historically fish distribution and habitat associations impacted by development activities in this region have been assessed using literature derived from southern populations. In this study, quantitative modelling tools will be tested to determine the accuracy of habitat suitability index scores among nine species in the Kivalliq region of Nunavut. Data will be sourced from white and gray literature north of 60 collected since Richardson, et al. (2001). Preliminary results indicate that seven of nine species are currently assessed using 50-90% of geographically invalid data. Furthermore, field sampling at a Nunavut gold mine in August of 2018 will be used to contribute to the overall understanding of fish habitat associations using northern data. The aim of this research is to: 1) provide an assessment of freshwater habitat associations in the Kivalliq region, 2) develop and standardize habitat suitability indices and tools for impact assessments and, 3) contribute to new protocols for the collection of fish community and habitat information in remote areas. The results will all aid in the evaluation and assessment of development impacts in Canada's north. (Oral)

Harper, D.L., Bethoney, N.D., Stokesbury, K.D.E., Lundy, M., Stokesbury, M.J.W., McLean, M.F.*. Acadia University. **Video survey techniques for estimating sea cucumber (*Cucumaria frondosa*) population dynamics for improved resource management within fishing areas.** With global demand for sea cucumber products increasing and some tropical stocks collapsing, it has opened an economic opportunity for Atlantic Canada where *Cucumaria frondosa* are plentiful. Resulting from slow growth and limited motility sea cucumbers are highly susceptible to over-exploitation. Sea cucumber fisheries have been developing off Eastern Canada for the past decade, but sea cucumber population dynamics remain largely unknown. As stock assessments and fisheries quotas are strongly influenced by these population dynamics, this lack of information could lead to mis-management and instability within the industry. For proper management for long-term sustainability of these sea cucumber fisheries, abundance and biomass must be estimated. To make these estimates, we are conducting fisheries-independent drop-camera video surveys of the fishing areas on the Scotian Shelf. With videos taken during the surveys we can approximate both abundance and biomass, as well as look at habitat preferences and species diversity. These new video assessment methods are not only less impactful on the environment but also provide more ecological information than standard trawl surveys. Moving forward, data from fisheries-independent video surveys in conjunction with data from on going trawl surveys and landings, will inform management of sea cucumber resources in eastern Canada or globally. (Poster)

Harris, C.M.*; Janisse, K.; Warriner, T.W.; Capelle, P.M., Love, O.P., Semeniuk, C.A.D. Great Lakes Institute for Environmental Research, University of Windsor, ON. **Predator-avoidance behaviours of juvenile Chinook salmon reared under differing maternal stress and temperature conditions.** Captive ecological behavioural trials frequently require trade-offs between simulating native habitats with biologically-relevant conditions and the requirements for researchers to be able to monitor targeted behaviours. Low light, cover vegetation, fast movements, and the inclusion of numerous visually-indistinguishable conspecifics provide significant challenges to observer and camera-based trials. Chinook salmon (*Oncorhynchus*

tshawytscha) were raised in experimental groups exposed to maternal stress signal (1000ng/mL cortisol or control), and reared at observed and elevated temperatures (+3°C). To assess whether experimental groups differed in their behavioural phenotypes, and if these behavioural differences provided performance and survival benefits in a stressful environment, we monitored fish habitat choice in a nature-simulated mesocosm with distinct habitat zones differing in safety and resource availability. Using an array of pass-through antennas to monitor juvenile Chinook salmon implanted with passive integrated transponder (PIT) tags we assessed fish behaviour in the presence of a PIT-tagged predatory rainbow trout (*Oncorhynchus mykiss*). This system allowed for continuous tracking of fine-scale habitat selection of multiple individuals and the predator over 24-hr periods while minimizing human disturbance. We recorded behaviours such as activity level, habitat preference, co-occurrence with predator, and movement in relation to the predator when the predator was both restrained and free in the mesocosm. This study reveals whether maternal stress signals prepare offspring for chronic (temperature) and acute (predation) stressful environments. (Poster)

Harrison, P.M.*, Ward, T., Algera, D.A., Leake, A.J., Cooke, S.J., & Power, M. University of Waterloo. **Turbine entrainment vulnerability of bull trout and lake trout in Williston Reservoir, BC.** Turbine entrainment, the involuntary downstream displacement of fish through hydropower turbines, can result in losses to upstream populations, and cause injury or death. *Salvelinus* species, provide an important recreational fishery in many Canadian reservoirs. However, the entrainment vulnerability of these reservoir resident fish species is not well established. Furthermore, the factors that influence occupancy of dam forebays, where entrainment risk is elevated, are not well understood. Here, we use acoustic telemetry to compare seasonal entrainment vulnerability patterns between two co-occurring, native char species, bull trout, *Salvelinus confluentus*, and lake trout, *Salvelinus namaycush*, in BC's largest reservoir, Williston Lake. We show that while entrainment rates were low for both species (<2%), lake trout displayed increased forebay use, increased proximity to the forebay, and were more likely to be entrained, in comparison to bull trout. Moreover, our findings indicate that while bull trout forebay use remained low in all seasons, lake trout showed a seasonal pattern of movement, with increased forebay occupancy during the winter and spring, and total avoidance of the forebay during the summer. We conclude with an exploration of hypotheses to explain this seasonal movement, and a discussion of the implications of our study for entrainment mitigation. (Oral)

Harrow-Lyle, T*. and Kirkwood, A.E. University of Ontario Institute of Technology. **Connecting the emergence of algal blooms in Lake Scugog to a possible invasional meltdown scenario.** Lake Scugog is a large, shallow lake in southern Ontario that serves as an important headwater to the Trent-Severn waterway. Historically, Lake Scugog has been a macrophyte-dominated ecosystem that supports a productive fishery. In recent years, algal blooms have been reported in Lake Scugog for the first time. During the same time period, *Nitellopsis obtusa* (Starry Stonewort), a non-native invasive macroalga was discovered in the lake. From 2016 - 2018, we conducted comprehensive field studies in Lake Scugog to assess the physical, chemical, and biological conditions across 12 sites. During each study year, *N. obtusa* was the dominant species in the macrophyte community. Moreover, the non-native invasive mussel *Dreissena*

polymorpha increased, and algal blooms were documented (dominated by *Microcystis* sp.). To understand the drivers of algal blooms in Lake Scugog, both multiple regression and structural equation modelling was used. Despite *Microcystis* sp. having a positive relationship with total phosphorus and *D. polymorpha*, the only statistically significant factor was the relative abundance of *N. obtusa* ($p < 0.05$). These findings show for the first time a potential role for *N. obtusa* in promoting *Microcystis* blooms in an inland lake. Future work will test this model across Ontario lakes. (Oral)

Hasler, C.T.*; Denton, D.; Patterson, S.A.; Blais, J.M.; Palace, V.; Hanson, M.; Hollebhone, B.P.; Rodriguez-Gil, J.L.; Orihel, D.M. The University of Winnipeg. **Behavioural responses to diluted bitumen in wood frog tadpoles.** The study of animal behaviour in an ecotoxicological context allows for a broader understanding of pollution effects on ecosystems. Amphibians in aquatic ecosystems are vulnerable to contaminant exposure, especially during early life stages when they are contained within a waterbody. In Canada, a recent issue has been pipeline development and there is potential for diluted bitumen to spill into aquatic ecosystems where sensitive amphibian populations live. Thus, there is a need for field studies to assess behavioural effects of diluted bitumen on amphibian tadpoles. In this study wood frog (*Lithobates sylvaticus*) tadpoles were reared and subsequently exposed to boreal lake water from limnocorrals treated with various concentrations of diluted bitumen. A total of 166 video recordings of groups of tadpoles within arenas were collected. Activity patterns, personality traits, space-use, and sociability were measured and compared across several concentrations of diluted bitumen. (Oral)

Hauger, M.D.*; Mullen, E.; Mckennitt, M.; Kroeker, D.; Murray, L.; Jeffries, K. University of Manitoba, Winnipeg. **Understanding black crappie population characteristics and movement in Whiteshell Provincial Park.** Black Crappie (*Pomoxis nigromaculatus*) are a widely distributed freshwater fish in North America. Little is known about population characteristics along the northern edge of their distribution range. In this study we looked at populations of Black Crappie located in the Whiteshell Provincial Park, Manitoba, in a series of inter connected lakes (North Cross, South Cross, and Caddy Lake). We examined age and growth data to determine size structure, age structure, and mortality rate within those lakes. We wanted to examine how age structure varied among the lakes. Between May and August 2018, we collected data on $n=372$ in North Cross Lake, $n=338$ in South Cross Lake, and $n=301$ in Caddy Lake. We also tagged fish with external anchor tags to look at Black Crappie movement, specifically at the use of passage ways between lakes. In order to inform future management decisions, it is important to understand the population characteristics of these fish, as they are a popular recreational sport fish in Manitoba. (Poster)

Hayhurst, L.D.*; Metcalfe, C.D; Rennie, M.D. Canada. **Biomarker and bioenergetic effects of a whole-ecosystem nanosilver addition on Yellow Perch (*Perca flavescens*) at the IISD-Experimental Lakes Area.** Nanosilver (nAg) describes particles of silver 1-100 nanometers in size with inherent antibacterial properties. Nanosilver occurs in over 440 consumer products; broad-scale applications have the potential to release nAg into the environment in greater-than-ever quantities at point sources. No regulations currently exist for nAg environmental

release in Canada. To assess whole-ecosystem impacts of this contaminant, environmentally-relevant concentrations (1-15µg/L) of nAg were added to a lake at the IISD-Experimental Lakes Area for two years. This study investigated tissue accumulation of total silver (Ag+) and cellular-level responses in fish, as well as individual- and population-level effects of the nAg addition using bioenergetics models. Results were compared to a nearby reference lake monitored over the same period. Concentrations of Ag+ in perch liver and gill tissues were significantly higher (<0.5µg/g) than baseline levels (<0.005µg/g) in the first year of nAg addition. This manifested as reduced consumption and total metabolism during and after nAg addition at the individual-level. Perch population bioenergetics indicated suppressed gross consumption during and after nAg addition, compared to the reference lake. We determined these nAg environmental release levels and duration were detrimental to fish. This research will directly influence policy development on the use and release of nAg into freshwater. (Poster)

Hayhurst, L.D.*; Metcalfe, C.D.; Rennie, M.D. IISD-Experimental Lakes Area. **Individual- and population-level effects of a whole-ecosystem nanosilver addition on Yellow Perch (*Perca flavescens*) at the IISD-Experimental Lakes Area.** Nanosilver (nAg) is an effective antibacterial and antimicrobial agent; its widespread use has high potential for release into freshwater environments. Nanosilver is currently unregulated in Canada, and may require a separate regulatory framework for policy on environmental release. As part of a collaborative nAg addition study (environmental concentrations = 1-15µg/L) conducted at the IISD-Experimental Lakes Area, we evaluated changes in Yellow Perch (*Perca flavescens*) bioenergetics at the individual- and population-level for comparison before, during, and after whole-lake nAg addition. Biomarkers for acute total silver (Ag+) toxicity examined direct effects on perch muscle tissue, gills, liver, and stomach. Results were compared to a nearby unmanipulated reference lake monitored over the same period. Perch consumption and metabolism decreased during and after nAg addition, while growth rates, conversion efficiency, and abundance were not significantly different between study periods. Biomarker results revealed significant concentrations of Ag+ in perch liver and gills, as early as the first season of nAg addition. Based on these results, nAg had significant direct impacts on perch at the cellular-, individual-, and population-levels during the two years of nAg exposure. This study evaluated fish effects in relation to the rest of the ecosystem - achievable only through whole-ecosystem experimentation. (Oral)

Heath, D.D.*; Wellband, K.; Balasingham, K.; Ens, J; Johansson, M. Great Lakes Institute for Environmental Research, University of Windsor. Canada. **Genetic tracking of an invasion: Round goby in the Great Lakes.** Aquatic Invasive Species pose a major threat to almost all aquatic ecosystems around the world and an extraordinary level of research effort has been focussed on all stages of the invasion process, with ecology, computer simulation, evolution, physiology and genetics all contributing. However, we propose that the most detailed characterizations of invasion events involved novel and inventive applications of genetics, genomics and transcriptomics. In this presentation, we will summarise a diverse array of genetic-based analyses of the Round Goby (RG) Great Lakes invasion; work representing over 10 years of study in the Heath Lab. Population genetic analyses using microsatellite markers and extensive field sampling document the pattern of colonization, and highlight some of the

novel RG dispersal mechanisms used in their Great Lakes invasion. eDNA meta-barcoding of two Great Lakes tributaries demonstrates the extent and pattern of riverine invasion by the RG, and the resulting fish community effects. Finally, our comparative transcriptomics of the successful RG with a less successful species provides insight into the mechanisms behind the remarkable invasion of the RG. Genetic study of specific invasions provides unique insights into the process; however, such analyses may also provide answers to fundamental questions about how AIS invade new ecosystems. (Oral)

Heer, T.*; Wells, M.G., Mandrak, N.E. University of Toronto Scarborough. **Using a 3-D hydrodynamic model to predict Grass Carp spawning success.** Due to the potential for a Grass Carp invasion in the Great Lakes Basin, there is a focus on identifying spawning tributaries to the Great Lakes. Modelling Grass Carp egg movement in water is a potentially useful method, as spawning success is determined by egg suspension in the water column at the time of hatching. A case study will be presented on the development of a river model on the Sandusky River, a tributary to Lake Erie, where Grass Carp are currently spawning. Existing methods of predicting egg movements in a velocity field, using a Lagrangian Particle Tracker and a temperature-dependent hatching model, are integrated into a commercial three-dimensional hydrodynamic model (EFDC Explorer). The model was calibrated and validated using water level and velocity measurements taken during a high flow event. Egg capture data, which includes egg developmental stage, location and time of capture, are used to validate model outputs. Model spawning runs successfully recreate egg capture data and indicate that Grass Carp could successfully spawn in the Sandusky River at distances shorter than previously assumed. This model provides a tool to predict spawning success of Grass Carp, which can be used to inform management decisions on preventative strategies. (Oral)

Henderson, R.I.*; Salk, K.R.; Schiff, S.L.; Venkiteswaran, J.J. Wilfrid Laurier University. **Diel trends in stable isotope values of dissolved inorganic carbon in a eutrophic boreal lake.** Algal blooms are increasingly being reported in small Canadian Shield lakes. Highly productive blooms cause daily drawdown of dissolved organic carbon (DIC) and elevated pH, leading to replenishment of the DIC pool through chemically enhanced diffusion (CED) of atmospheric CO₂. Photolysis of dissolved organic carbon and respiration of terrestrial material and epilimnetic sediments are additional sources of DIC not dependent on high pH. Parsing the contributions of individual carbon sources to the DIC pool and their incorporation into the aquatic food web can be achieved by evaluating $\delta^{13}\text{C}$ values of DIC. DIC concentrations and $\delta^{13}\text{C}$ -DIC were collected hourly between sunset and sunrise at Lake 227, an artificially eutrophied softwater lake at the IISD Experimental Lakes Area in northwestern Ontario that experiences two annual algal blooms. Sampling occurred following the first cyanobacteria-dominated bloom, and during the subsequent bloom dominated by eukaryotic algae. Despite differences in pH, temperature, biomass, and DIC between the two sampling events, a similar pattern in $\delta^{13}\text{C}$ -DIC was observed: beginning at sunset, $\delta^{13}\text{C}$ -DIC fell steadily before stabilizing at approximately -9‰ nearing sunrise. Although CED has been identified in Lake 227 in previous studies, the $\delta^{13}\text{C}$ -DIC values of these samples do not reflect a strong influence of CED overnight. (Oral)

Higgins, S.N.*; Desjardins, C.; Drouin, H.; Hrenchuk, L.; van der Sanden, J. IISD Experimental Lakes Area. **The role of climate and lake size in regulating the phenology of ice-cover.** A growing number of studies have reported declining trends and increasing intra-annual variance ice-cover duration on lakes across temperate latitudes, including Canada's boreal region. We report the long-term trends (1970-2017) and drivers of ice phenology for a 50-ha boreal lake, and a contemporary study (2016-2018) using direct and satellite observations to evaluate regional variation of ice phenology across 30 lakes representing a lake size gradient (2-2600 ha). Temporally, the duration of ice-cover declined by ~4 days/decade since 1970 and both ice-on and ice-off dates were highly predictable from seasonal air temperatures. Ice-on dates were strongly and non-linearly influenced by lake size with larger lakes freezing 30 to 45 days later than the smallest lakes. Despite similar meteorological conditions, ice-off dates were also strongly and non-linearly related to lake size with larger lakes thawing 10 to 21 days later after the smallest lakes. Our results indicate that despite regional homogeneity in snowfall, increases in lake size were associated with reductions in snow thickness, leading to increases in ice-thickness and delays in ice-off dates. The total duration of ice-cover was also non-linearly related to lake size, with the largest lakes having 24-38 more ice-cover days than the smallest lakes within the study. (Oral)

Holub, R.R.* and McLaughlin, R.L. Integrative Biology, University of Guelph. **Individual differences in behaviours do not influence trapping efficiency of invasive Sea Lamprey (*Petromyzon marinus*) in the St. Marys River.** Understanding individual differences in behaviour could benefit the management of invasive species. The invasive Sea Lamprey is a target of a binational control in the Great Lakes since the 1950s that has included trapping. Highly efficient trapping could be a valuable control method in large rivers, but individual differences in behaviour could bias trap catches and reduce trapping efficiency. We tested if individual differences in time to enter a novel environment (risk taking) and proportion of time moving (activity) in standardized tests were related to individual probabilities of trap encounter (field) and trap catch (lab + field) in the St. Marys River. Individuals were PIT tagged, measured for behaviour, and released in the river. PIT antenna and trap checks quantified encounter and trap catches. We found repeatability in the lab for risk taking and activity among individuals, and partial evidence that behavioural biases capture in small-scale lab conditions. However, in the field, we found no evidence that risk prone, active individuals were more likely to encounter and be trapped than risk averse, inactive individuals. Concerns for how individual differences in behaviour could reduce trapping efficiency remain unsupported. (Oral)

Hoskin, G.N.*; Korosi, J.B.; Kirkwood, A.E.; Thienpont, J.R. York University. **Investigating ecosystem responses to multiple interacting anthropogenic stressors in McLaughlin Bay (Oshawa, Ontario).** Great Lakes coastal wetlands are integral to the Laurentian Great Lakes ecosystem, and many of Canada's Great Lakes coastal wetlands are located within urban and suburban areas where they have been subject to multiple intense anthropogenic stressors since European settlement. Coastal wetlands of southern Ontario have experienced significant watershed development over the past several decades, and consequently many now exhibit poor water quality, low vegetation diversity, and habitat degradation as a result of associated stressors like increased road salt and nutrient runoff, invasive alien species introductions, toxic

effluents, and shoreline destruction. This study uses Cladoceran subfossils as ecological indicators to track environmental change from ~1850 to present day in McLaughlin Bay, a highly degraded coastal wetland located in Oshawa, Ontario. McLaughlin Bay presently suffers from high conductivity, high turbidity, degraded shorelines, and invasive species, among many other anthropogenic stressors. The results from this study will be used to determine if and how McLaughlin Bay is responding to these stressors, and if the wetland is showing signs of recovery. Understanding how ecosystems respond to human activities and their subsequent recovery will help to inform management and restoration plans and add to the growing body of knowledge regarding anthropogenic impacts on wetland environments. (Oral)

Hrenchuk, L.E.*; Bulloch, P.; Dearnley, J.; Dettman, H.; Greer, C.; Hanson, M.; Higgins, S.; Paterson, M.; Peters, L.; Shanoff, T.; Taylor, E.; Timlick, L.; Tomy, G.; Wiseman, G.; Palace, V. IISD Experimental Lakes Area. **Freshwater Oil Spill Remediation Study (FOReSt): Examining natural attenuation of oiled shorelines and effects of residual oil on biota at IISD-ELA.** Potential environmental impacts of oil spills are a concern for the Canadian public and oil industry. Additional scientific data and guidance regarding the best methods to employ when cleaning up oil spills in different environments are needed to support regulatory decisions. IISD Experimental Lakes Area is leading a collaborative program comparing clean-up methods for oil (weathered diluted bitumen and conventional heavy crude) in freshwater shoreline environments. Baseline chemical and biological information were collected in 2017. In 2018, controlled oil spills in contained shoreline environments were conducted to quantify the efficiency of immediate product recovery, and then to compare degradation of residual polycyclic aromatic hydrocarbons (PAH) and their alkylated homologs via natural attenuation. Microbial community responses and impacts of residual oil on biota were evaluated in the enclosures over 16 weeks. Information from this portion of the project will be used to determine if degradation trajectories and residual ecological effects are significantly different for diluted bitumen and conventional heavy crude oil. Results will also be used to guide the design of a larger project to be undertaken in 2019 that will compare the efficacy of different shoreline clean-up techniques, and the subsequent fate and behaviour of residual oil. (Oral)

James, T.L., LeBris, A., Landsman, S.J., van den Heuvel, M.R. Canada. **Migratory movements of adult Atlantic halibut in the southern Gulf of St. Lawrence.** Atlantic Halibut in the Maritimes region are presumed to be separated into two stocks: Scotian Shelf and Gulf of St. Lawrence (GSL). There is some belief that halibut in the southern GSL form a discrete stock separate from individuals in the northern GSL. Pop-up satellite archival tags were deployed on adult halibut during fall 2013 and 2014, and were programmed to release one year later. Using tag deployment and pop-off locations as fixed reference points and assuming the maximum dispersal rate of halibut, a Hidden Markov Model was used to compute a geolocation using temperature and depth data. Movement tracks indicated dispersal from putative feeding grounds beginning mid-late fall with directed movements to the Laurentian Channel and Cabot Strait. Spawning rises were recorded for multiple individuals near the deepest part of the Cabot Strait. Halibut were recorded moving back to summer feeding grounds off PEI. Supplemental Floy tagging data also suggested fidelity to PEI feeding grounds, with 88.4% of recaptures occurring less than 100 km from the original tagging location. As no fish were tracked moving

out of the GSL and onto the Scotian Shelf, these data provide support for managing the GSL and Scotian Shelf/Grand Banks populations separately. (Oral)

Jarvis, L.*; Chu, C.; McMeans, B. University of Toronto. **Considering the cumulative effects of environmental, biological and anthropogenic stressors on walleye productivity.** Fisheries' health is vulnerable to the persistent threat of global change. In response to climatic or developmental changes fish alter their behaviour to maximize resource consumption or minimize energetic costs. These behavioural changes depend on the temperature preferences of individual species of fish, which can be broadly categorized into thermal guilds of cold-, cool- or warm-water species. However, additional stressors such as angling pressure and resource availability interact to heighten or mute temperature effects on these uniquely responding thermal groups. My research seeks to determine how the cumulative effects of such biological, ecological and anthropogenic stressors alter the productivity of key predatory fish species that belong to different thermal guilds. Here, I explored how the productivity of walleye, a cool-water fish species, changed across a spatial temperature gradient. Across this gradient, I found that walleye productivity decreased with increasing temperatures. Further analyses using Boosted Regression Trees and Random Forests suggest that this pattern is unrelated to prey biomass, but instead lake shape and angling pressure. By demonstrating that the cumulative effects of multiple stressors interactively determine walleye productivity, these results will help inform predictive models and anticipate fisheries' health under continuing environmental change. (Oral)

Jeanson, A. L.*; Cooke, S. J., Young, N. Carleton University. **Recreational angler perceptions in a changing world: implications for recreational fisheries management and policy development.** Recreational fishing is a valuable pastime for many Canadians and for the Canadian economy. Unfortunately, climate change coupled with other anthropogenic stressors continues to alter aquatic ecosystems, generating considerable uncertainty about the future of sustainable recreational fishing. As the success of recreational fisheries management is highly dependent on the willingness of anglers to adapt to changing environmental conditions and new regulations, angler perceptions to climate change and to changes in policy development and management strategies within the sector are of interest. This presentation will deliver findings from an online survey that received over 1000 rainbow trout and steelhead angler responses from BC, as well as from interviews with 42 steelhead anglers. These findings will give insight on angler perceptions to climate change and other threats, the willingness of anglers to continue to fish in a changing world, angler thoughts on current and future fisheries management, as well as stocking and hatchery reared fish. In partnership with public agencies, and as part of a larger multidisciplinary research project funded by Genome BC and Genome Canada, these findings will later contribute to the development of management strategies and conservation policies for a sustainable recreational BC rainbow trout fishery in an uncertain future. (Oral)

Jeffrey, J.D.*; Gaudry, M.J., Enders, E.C., Jeffries, K.M., Treberg, J.R. University of Manitoba. **Assessing the physiological status of walleye (*Sander vitreus*) across two contexts in Manitoba.** Walleye represent an important fish for commercial and recreational fishing in Manitoba; however, little is known about their physiological status within and across locations.

Two studies were carried out using non-lethal sampling and molecular tools to assess the physiological status of walleye. As part of a larger study on walleye movement patterns in Lake Winnipeg, walleye were sampled for gill and blood from 3 locations. Shorter telomere lengths, a proxy of stress, were detected in fish from the Red River, near the South Basin of Lake Winnipeg, compared to fish from the North Basin. Gill samples were also used to sequence the transcriptome of walleye, yielding a novel toolbox to assess gene expression in this species. Utilizing the transcriptome, a gene suite approach was used to assess the status of walleye in the southern part of Lake Manitoba, where walleye become trapped in the Delta Marsh throughout the summer by a common carp exclusion fence. Walleye showed patterns of gene expression consistent with exposure to increased temperatures and decreased oxygen with longer holding in the marsh. Together, these studies provide development and evidence for the effectiveness of molecular tools in assessing the status of a species of economic and conservation concern in Manitoba. (Oral)

Jeffries, K.M.*, Thorstensen, M.J., Jeffrey, J.D., Watkinson, D.A., Enders, E.C., Treberg, J.R. University of Manitoba. **Integrating molecular and metabolic indices with walleye movement patterns in Lake Winnipeg.** Lake Winnipeg, Manitoba, has experienced significant alterations due to the cumulative effects of eutrophication, the introduction of invasive species and commercial fisheries. Lake Winnipeg also supports the second largest freshwater fishery in Canada with walleye (*Sander vitreus*) being a focal species. In 2017 and 2018, we conducted a study to evaluate how the movement of individually-tagged wild-caught walleye from distinct spawning regions related to molecular indices of health. Understanding of the overall, and regionally specific, biology of fishes in telemetry studies can be improved by collecting tissues non-lethally during the tagging surgery. In our study, a subset of walleye were sampled for gill tissue (n = 48) for RNA-sequencing to examine transcriptome differences between fish at three different capture locations (i.e., spawning locations in tributaries of the North and South Basin, and an intermediate site). Using the transcriptome profiles, we are able to compare the health of individuals at the time of tagging between the different locations and link transcript levels with movement patterns in Lake Winnipeg. This work is part of an ongoing investigation integrating movement patterns and physiological indices of an economically important fish species in Manitoba. (Oral)

Jeyarajah, J.*, Thienpont, J., Harrow-Lyle, T., Kirkwood, A., & Korosi, J. York University, Canada. **Assessing Historical Data and spatial variation in Cladoceran species assemblages in Lake Scugog.** Lake Scugog is a large, shallow, nutrient-rich, and macrophyte dominated lake, located within Durham and Kawartha Lake regions of Ontario. Multiple stressors impact water quality in Lake Scugog, most notably eutrophication and invasive species. We are employing a paleolimnological approach to understand how multiple stressors drive long-term ecological change in Lake Scugog, using Cladocera subfossils as ecological indicators. Cladocera are a diverse group of small freshwater invertebrates that are sensitive to various environmental disturbances. We examined cladoceran assemblages and diversity in surface sediments from multiple sampling points in Lake Scugog, in order to better understand ecological controls on spatial variability of Cladocera and explore their potential use as ecological indicators. To complement the spatial assessment, we collected sediment cores from both the east and west

basins of Lake Scugog to track changes in cladoceran assemblage, diversity, and size structure over the last several hundred years. This study will inform on the usefulness of using Cladocera as ecological indicators of near-shore aquatic ecosystem health. (Oral)

Jeziorski A.*, Griffiths K., Simmatis B., Gregory-Eaves I., Antoniadis D., Smol J.P. Canada. **Paleolimnological data from the Canadian LakePulse Network 2017 field campaign (Eastern Canada)**. The NSERC Canadian LakePulse Network (www.lakepulse.ca) is a collaborative scientific effort between experts from a variety of disciplines working to better understand, manage and conserve Canada's limnological resources on a national scale. The Network is currently conducting a survey of 680 Canadian lakes (spanning a range of impact levels across 11 ecozones), to create a nationwide baseline dataset for a wide variety of limnological variables including water chemistry, optical properties and sediment indicators. Paleolimnological analyses of lake sediments obtained by the survey (both "Top-Bottom samples and full gravity cores) are being used to examine changes in Canadian lakes over the Anthropocene and their susceptibility to different stressors. In 2017, the first LakePulse field campaign sampled 217 lakes in Eastern Canada spanning four ecozones (Atlantic Highlands, Atlantic Maritime, Boreal Shield, and Mixedwood Plains). Here, we present preliminary paleolimnological results from selected lakes, with a focus on sediment dating efforts, spectral inferences of chlorophyll a, characterization of sedimentary chironomid and diatom assemblages, as well as chironomid-inferred volume weighted hypolimnetic oxygen (VWHO) concentrations. (Oral)

Johnston, T.A.*; Heerschap, M.J.; Keller, W.; Gunn, J.M. Ontario Ministry of Natural Resources and Forestry, Cooperative Freshwater Ecology Unit, Canada. **Ecology and food quality of riverine fish populations of the Hudson Plains Ecozone, northern Ontario**. Rivers of the Hudson Plains Ecozone (HPE) support important subsistence fisheries but fish resources of these systems remain poorly studied. We examined fish populations from the lower reaches of 14 HPE rivers in terms of growth, trophic ecology, and food quality, and compared them with upstream lacustrine populations. Compared to inland lakes of the same drainage basins, river populations of northern pike and walleye grew faster and occupied broader trophic niches. In contrast, lake whitefish tended to grow more slowly in the rivers than in inland lakes. Stable isotope and fatty acid compositions indicative of predation on marine food sources were most evident in presumed anadromous species - brook trout, lake whitefish and cisco. Mercury concentrations were significantly higher in river than in inland lake populations of walleye, lake whitefish and white sucker, but not northern pike. Both mercury and essential fatty acid concentrations of fish muscle varied among rivers but there did not appear to be spatial concordance between them. Presumed anadromous species tended to have both the highest essential fatty acid concentrations and among the lowest mercury concentrations, making them an especially high quality food source (Oral)

Jones, N.E., and Schmidt B.J. River and Stream Ecology Lab, Ontario Ministry of Natural Resources and Forestry, Trent University, Peterborough. **An aquatic ecosystem classification for Ontario's rivers and streams**. Essential to the management of natural resources is an understanding of what, where, and how much is present in an administrative region. Without

this knowledge it is difficult to manage and report on status of resources or evaluate management efforts and policy. We present an overview of a classification system for Ontario's flowing waters. Our objectives were to (i) develop a consistent spatial framework for streams and lakes, attribute stream reaches, group stream reaches into stream segments, and classify streams across the entire province of Ontario. The resulting map product will be useful for multiple purposes and at a variety of spatial scales (e.g., fundamental understanding, monitoring and reporting, species distribution modelling). Our classification and mapping is novel in that it covers a very large spatial extent, incorporates lakes into the classification of flowing water, and involves a process that is applicable to other provinces, states, and countries where field data is lacking but remotely sensed data is available. (Oral)

Kajtar, A.*; Devlin, R.; Heath, J.W.; Heath, D.D. University of Windsor, Canada. **Mapping the plume of Environmental DNA from a Chinook salmon farm in a well-mixed saltwater ecosystem.** Environmental DNA (eDNA) is extracted from microscopic traces of an organism as cells are shed into their aquatic environment. The ability to extract and characterize aquatic eDNA has increased the sensitivity of molecular surveillance and conservation efforts. With increased fish farming around the world as an important food supply, the impact of high densities of native and non-native species on wild aquatic ecosystems remains unclear, especially considering the high influx of nutrients into the surrounding environment. In collaboration with a Chinook salmon farm on the east coast of Vancouver Island, we collected water samples around the saltwater sea pen system. To quantify the impact of fish farming on the surrounding environment, we sampled water at three depths (1m, 5m, 10m) on a grid extending 1000m from the sea pen system. We designed mitochondrial DNA markers to detect Chinook to establish a three-dimensional concentration map across the sampled area. Using distance and depth of salmon eDNA being discharged into the environment, we can assess the radius extent of nutrient discharge from a fish farm. This research demonstrates a novel way of assessing the ecological impact of marine farming, which can be applied to multiple aquacultural practices, covering different species reared under different governmental regulations. (Oral)

Kanagasabesan, T.*; MacLatchy, D. Wilfrid Laurier University. **Exploring physiological mechanisms for 17alpha-ethinylestradiol exposure tolerance in mummichog (*Fundulus heteroclitus*) across ovarian development.** The endocrine disrupting compound 17 α -ethinylestradiol (EE2), is linked to organism-level (hormone physiology/development) and population-level (egg production) effects in fish. Compared to model freshwater teleosts, estuarine *Fundulus heteroclitus* (mummichog) egg production is less sensitive to EE2 exposure; this may be due to differences in ovarian physiology, including 17 α -estradiol (E2) regulation. In most teleost fish, there is a shift from estrogens (such as E2) to progestogens (such as maturation inducing steroid; MIS) as follicles progress to early maturation. However, in mummichog there is no shift detected, as levels of E2 are consistently higher in all stages of follicular development. Plasma and ovarian follicles from maturing mummichog were collected and grouped into five stages of maturation; follicular steroid production and/or gene expression in hormone signalling and steroidogenic pathways were assessed by stage. Plasma and follicular production of E2 increased as the ovarian maturation cycle progressed, and

dropped after maturation; whereas MIS was equally expressed during development and early maturation stages, and increased in late maturation and ovulation stages. Differences between mummichog and other teleosts in maturational gene expression include: expression of P450 c17 (converts pregnenolone to $17\alpha\pm$ -hydroxypregnenolone and dehydroepiandrosterone) and follicle stimulating hormone receptor (FSHr; key gonadotropin responsible for ovarian development) drop earlier in the maturation cycle, P450 aromatase (converts testosterone to E2) is evenly expressed through all stages prior to dropping at late maturation, and luteinizing hormone receptor (LHr; key gonadotropin responsible for ovarian maturation) peaks earlier in maturation than expected. (Poster)

Kess, T.*; Dempson, B., Lehnert, S.J., Bentzen, P., Salisbury, S., Messmer, A., Duffy, S., Ruzzante, D., Nugent, C.M., Ferguson, M.M., Leong, J.S., Koop, B.F., Bradbury, I.R. Department of Fisheries and Oceans. **Extreme morphological divergence corresponds to heterogeneous genomic divergence and deep-water adaptation of sympatric Arctic charr (*Salvelinus alpinus*) morphs in Gander Lake Newfoundland.** Colonization of postglacial lakes following ice-sheet retreat has enabled exploitation of novel freshwater environments by Arctic charr (*Salvelinus alpinus*) throughout the northern hemisphere. Emergence of these freshwater habitats has resulted in recent and repeated adaptive radiation into sympatric ecotypes, yet the genomic basis of these radiations, and particularly of extreme phenotypes, remains poorly understood. Here, we characterize an extreme case of morphological divergence between two sympatric Arctic charr morphs found in Gander Lake, Newfoundland. We quantify phenotypic divergence and genomic divergence between a pale, small demersal morph exhibiting extensive morphological adaptation to extreme aphotic depths (300m) with a dark morph inhabiting littoral habitats. Using geometric morphometric comparisons and 5152 polymorphic genome-wide SNPs, we show that these ecotypes are significantly morphologically and genetically discrete ($F_{ST}=0.074$). We find evidence of heterogeneous genomic divergence, suggesting adaptation to the deep-water environment of Gander Lake is underlain by islands of genomic divergence (outlier $F_{ST}=0.3$). These results, based on an extreme example of recent post-glacial radiation, provide insight into the genomic mechanisms facilitating the evolution of ecotype formation in Arctic charr and more generally in adaptation to aphotic deep-water environments. (Oral)

Kim, Jihyeon*; Prairie, Yves. Université du Québec à Montréal. **Pan-Canadian picture of lakes contributions to the global GHGs emissions: preliminary results from the first Lake Pulse campaign in Eastern Canada.** Natural lakes comprise about 91% of all inland waters and have been recognized as multiple players in local, regional and global carbon cycle especially by emitting a significant amount of greenhouse gases (GHGs), to the atmosphere. These estimates, however, can be underestimated and poorly constrained because they are often derived from averages with a lack of datasets of sufficient geographical coverage. Therefore, providing substantial datasets and better integration of them are needed to improve our understanding in lakes GHGs dynamics and fluxes. As part of the first field campaign of the pan-Canadian Lake Pulse program, we quantified and mapped accurate air-water fluxes of the two dominant GHGs (CO_2 and CH_4) by directly measuring in situ concentrations of them in 217 lakes across a wide range of environmental gradients in Eastern Canada. Our preliminary results from the first-year campaign showed that the diffusive fluxes of CO_2 and CH_4 were highly variable (mean -1.9 ± 9.3

and 1.1 ± 1.9 SD $\text{mmol m}^{-2} \text{d}^{-1}$, respectively). Among 5 ecozones in the Eastern Canada, Mixedwood Plains ecozone had higher CO_2 (56%) and CH_4 (61%) concentrations than other ecozones, indicating significant contributions of human impact to lake carbon emissions. (Oral)

Kindree, M.M.*, Jones, N.E., Mandrak, N.E. University of Toronto. **Predicting the interactions of native and invasive stream fishes to multiple stressors.** Global climate warming has been identified as an important stressor in freshwater systems, as environmental temperature is a key predictor of a species' distribution and affects the fitness of individuals. Climate change is expected to have a synergistic effect with species invasions through increased vulnerability of ecosystems to invasions by climatic suitability decreasing for native species and increasing for invasive species, thus destabilizing local communities. Native White Sucker and invasive Round Goby were chosen as candidate species to test the hypothesis that negative interactions between native fishes and invaders will be exacerbated with climate change. The White Sucker is an important energy transfer link between the nearshore and Lake Ontario tributaries and is currently in decline. This research examines the response of these native and invasive species to climate change by measuring their agitation temperature and critical thermal maximum (CtMax) under seasonal conditions to predict their potential future interactions under a warming climate. Agitation temperature and CtMax will be determined through stream-side experiments in three Lake Ontario tributaries. We hypothesize that Round Goby will have a higher agitation temperature and CtMax, due to their wider thermal tolerance window, allowing persistence in streams when conditions become unfavourable for the White Sucker. (Oral)

Kirkwood, A.E.*. University of Ontario Institute of Technology. **Co-production as a viable model for freshwater research in Canada.** The freshwater research space in Canada has significant breadth and depth, but it is not matched by available public funding to support the array of research that needs to be done. So what is a limnologist to do when the dominant funding paradigm (i.e., NSERC) cannot fulfill research demand? We look to the co-production model. Co-production is a formalized term used to describe research that includes stakeholders in the research process, not just as end-users (e.g., citizen science). My presentation will explore the viability of co-production as a sustainable research model in freshwater science, using case studies from my own experience with community partners and citizen scientists. I will also present research highlights from my collaborations with municipalities, conservation authorities, and stewardship groups. All of these co-production partnerships share a common research theme that focuses on water quality issues in freshwater ecosystems, from local to regional scales. The experience gained from these community partnerships has led to new projects, as well as new collaborations with other aquatic scientists. Overall, I hope my presentation conveys an optimistic perspective on the diverse paths to research funding and support, in addition to the societal value of building co-production research initiatives. (Oral)

Klemt, W.*; Hall, R.I.; Wolfe, B.B. Canada. **Flood-influenced lakes as archives of natural and anthropogenic trace metal deposition in the oil sands region: an approach to define pre-industrial baseline conditions.** Alberta oil sands development began in 1967, but environmental monitoring began 30 years later. Consequently, no pre-industrial baseline exists

upon which current river sediment quality can be compared. This undermines our ability to determine the relative importance of contaminants supplied by natural versus industrial processes to downstream environments and the extent of Athabasca River pollution. We analyzed metals in sediment cores from flood-prone lakes along the Athabasca River upstream and downstream of oil sands operations within the Alberta oil sands region. When compared to pre-industrial baselines, normalized vanadium (V) and nickel (Ni) concentrations in recently deposited flood-derived sediment do not show evidence of pollution of Athabasca River sediment. There is, however, a clear signal of V and Ni enrichment in recent decades in non-flood sediment at lakes located closest to mining operations, indicating local atmospheric pollution. Paleohydrological and contaminant analyses from flood-prone lakes along the Athabasca River provide a promising approach to establish reference conditions for the river and to discern natural and pollutant pathways of contaminant deposition. As we demonstrate, the pre-industrial baselines can be used to evaluate river-bottom sediment collected by oil sands monitoring agencies for evidence of pollution. (Oral)

Kroeze, S.L*; Boreux, M; Robinson, C.; Roy, J.W.; Yates, A.G. Western University and Canadian Rivers institute. **The relationship between organic matter breakdown and groundwater fluxes in Kintore Creek.** Organic matter (OM) breakdown is an important ecological process, particularly in small, shaded, headwater streams where terrestrial carbon inputs are the primary energy source. Studies have shown OM breakdown to be strongly controlled by physicochemical conditions, especially temperature and nutrients. However, temperature and nutrients can vary within a stream because of groundwater inputs through the hyporheic zone. Yet, little is known about how OM breakdown rates may be impacted by groundwater fluxes into stream systems. To address this knowledge gap, we used a cotton strip assay to assess the relationship between OM breakdown and groundwater inputs in 19 reaches within the headwater branches of Kintore Creek, Ontario. Using Radon concentrations as a proxy for groundwater contribution to stream-flow we will test the hypothesis that spatial patterns of OM breakdown vary with groundwater inputs. Additionally, using a partial least squared (PLS) regression analysis, we will determine the physicochemical characteristics (e.g., nutrients, temperature, dissolved organic carbon) that are the most likely mechanism through which groundwater fluxes influence OM breakdown. Results of our study will provide insight into the controls of this critical ecosystem process while also informing ongoing efforts aimed at applying OM breakdown as an ecological indicator for river health assessments. (Poster)

Lajoie, C, T. Drew, K. Loftus, M. Arts, R. Wehse, T. Pitcher*. Great Lakes Institute for Environmental Research, University of Windsor. **Differences in quality between hatchery-reared and wild-origin bloater (*Coregonus hoyi*) eggs.** Deepwater cisco species, such as the bloater (*Coregonus hoyi*), were once abundant in Lake Ontario and served as an important prey source for Lake Trout (*Salvelinus namaycush*). In the 1950s, bloaters had been presumably extirpated from Lake Ontario and as such, recent efforts have been made to re-establish a self-sustaining population using hatchery-reared bloaters. It is possible that individuals reared in captivity and released in the wild may hinder restoration efforts as they may be maladapted for the wild and have lower reproductive success than wild individuals. Egg quality, defined as the traits of an egg that allow for the successful development and survival of the embryo, can

greatly affect the reproductive success of an individual. In this study, we aim to compare egg quality traits between hatchery reared bloaters and wild-sourced bloaters, specifically gonadosomatic index, egg size and lipid content (to name a few metrics). Comparisons between wild and hatchery origin fish may lead to a better understanding of how released individuals may perform reproductively in the wild. Overall, this research will not only help contribute to the restoration of bloaters in Lake Ontario, but may also provide insight into the potential reproductive success of hatchery-reared individuals which are frequently used in conservation efforts. (Oral)

Lajoie, C.M.E.*; Warriner, T.R.; Pitcher, T.E; Semeniuk, A.D.; Love, O.P. University of Windsor. **The effects of senescence and female body condition on potamodromous Chinook salmon egg quality.** Semelparous Pacific salmon, such as Chinook salmon (*Oncorhynchus tshawytscha*), undergo drastic physiological and morphological changes during migration to reach their natal streams where they spawn and die. Salmon undergo rapid senescence during this time, characterized by extreme investment in reproduction by sudden and irreversible deterioration of their soma. Studies have suggested that rapid senescence may be caused by impairment of the salmon's immune system due to elevated levels of cortisol. As a female salmon undergoes rapid senescence, maternal cortisol may also transfer to her eggs and subsequently affect offspring phenotype, performance, and fitness. In this study, we compared egg quality of females collected from Lake Ontario in the early stages of senescence to those in later stages (2016-2018). Late senescent females had significantly higher levels of egg cortisol, despite having similar egg size and lipid content. Our work suggests that offspring may face differential costs of developmental exposure to maternally-derived cortisol both within and across females in relation to the timing of senescence, independent of the effects of traditional egg quality metrics. Our work adds to a growing understanding of the effects of rapid senescence and maternal condition on gamete provisioning and offspring fitness. (Oral)

Lamothe, K.A.*; Drake, D.A.R.; Dextrase, A.J. Fisheries and Oceans Canada. **Characterizing species co-occurrence patterns of imperfectly detected stream fishes: informing repatriation of the imperiled Eastern Sand Darter.** Species repatriation efforts could help improve the recovery of imperiled species, but implementation of this conservation strategy requires a thorough understanding of the abiotic and biotic factors influencing species viability. Species co-occurrence patterns are especially understudied, in particular by omitting the effect of imperfect detection on negative, neutral, or positive associations within a community. Using repeat surveys from five southern Ontario, Canada Great Lakes tributaries, we quantified species co-occurrence patterns with the federally Threatened Eastern Sand Darter (ESD) and characterized how imperfect detection during sampling can influence inference regarding these relationships. We observed several positive associations between ESD and co-occurring species; however, most associations differed when imperfect detection was considered. Silver Shiner and Creek Chub were the only species where the (positive) co-occurrence relationship with ESD remained after accounting for imperfect detection. Negative species co-occurrence patterns with ESD were only realized when incorporating imperfect detection. Our models predicted several potential repatriation sites for ESD in formerly occupied habitats with high levels of

certainty. Overall, our results demonstrate the importance of imperfect detection and species co-occurrence patterns in planning repatriation efforts. (Oral)

Lapointe, N.W.R.*; Twardek, W.M.; Cooke, S.J. Canadian Wildlife Federation. **Assessing the fate of returning upper Yukon River Chinook Salmon (*Oncorhynchus tshawytscha*)**. Chinook Salmon (*Oncorhynchus tshawytscha*) complete an awesome migration >3000 km in the upper Yukon River, passing one barrier in the process. The Whitehorse Hydro Plant (WHP) was constructed in 1958 and a fish ladder has been passing fish there since 1959. The primary spawning grounds upstream of the ladder are known, but straying salmon are occasionally observed in the vast Southern Lakes, and it is unclear whether additional spawning grounds exist. Ladder attraction, entrance, and fallback rates are unknown, as is the length of time that fish are delayed at the WHP. The Canadian Wildlife Federation is collaborating with the Yukon Energy Corporation, Carleton University, Carcross/Tagish First Nations and other partners to track Chinook Salmon movement and address these uncertainties. Acoustic transmitters were implanted in 138 fish between 2017 and 2018. Pilot studies were conducted to validate whether capture and handling affected fish passage behaviour, and full fish passage research will begin in 2019. At least 90% of fish migrating past the fish ladder arrived at spawning sites and fallback after passing the dam was infrequent (7%), usually occurring after fish migrated several kilometers past the dam. Two fish (2%) migrated to unknown locations which may represent unknown spawning grounds. (Oral)

Larsen, M.L.*; Venkiteswaran, J.J.; Baulch, H.M.; Simon, D.F. and Sauv e, S. Wilfrid Laurier University. **Heavy rainfall and increased phosphorus concentrations drive early onset bloom in an Ontario reservoir**. Cyanobacteria-dominated blooms are an increasing threat to freshwater systems across the globe. As the incidence of nuisance blooms increases, there is a pressing need to better understand, predict, and manage the drivers of bloom development. In this study, we focussed on bloom onset, duration, and the taxonomic and toxin composition in Conestogo Lake, a flood control reservoir managed by the Grand River Conservation Authority in southwestern Ontario. An *Aphanizomenon flos-aquae* dominated bloom began in the eastern arm of the reservoir in mid July 2017 nearly 2 weeks following a heavy rainfall event that increased all forms of phosphorus within the reservoir. Three microcystin variants, including microcystin-LR, -YR, and -RR, were detected in samples during the bloom period, which lasted between 3 - 5 weeks depending on the location within the reservoir. Together, these findings indicate that water movement through the reservoir system, combined with temperature and bottom-water oxygenation, are key drivers for cyanobacterial blooms in Conestogo Lake. Management goals and mitigation strategies must be responsive to the complexity of drivers affecting blooms. For reservoirs with large watersheds, flow management may be one of the few options available for short-term bloom mitigation. (Oral)

Larsen, M.L.; Venkiteswaran, J.J.*; Baulch, H.M.; Schiff, S.L.; Higgins, S.N. Canada. **Constant nutrient loads yield a lake with changing cyanobacteria blooms**. Nuisance and harmful algal blooms impair water quality and threaten our use of lakes for recreation, fisheries, and drinking water. Managing and preventing blooms requires understanding their drivers to develop mitigation site-specific strategies. We used the environmental and climatic forcings as external

drivers that change the pattern of bloom growth and cessation in Lake 227, a small, softwater, experimentally eutrophied lake at the IISD Experimental Lakes Area. Since 1990, only phosphorus has been added to the lake during the open-water season, making this a multi-decadal replicated experiment in time. We observed a gradual transition from a single, long mid-season bloom of the nitrogen-fixing cyanobacteria, *Aphanizomenon*, into two shorter blooms. The early bloom is heavily dominated by *Aphanizomenon* whereas the later bloom is more diverse. Nevertheless, the total phytoplankton biomass has remained relatively consistent over the last 27 years. This pattern may be partially driven by a nearly two-week increase in the number of ice-free days that increased the length of the stratified season. Together, the results demonstrate that even within a strictly controlled nutrient-addition experiment, bloom topology and composition will change. This means that managing freshwaters with varying external nutrient loads requires recognizing that recovery targets are constantly moving. (Oral)

Leclair, A.T*; Drake, D.A.R; Mandrak, N.E. Canada. **It's getting hot in here! Seasonal variation in critical thermal maxima of reidside dace (*Clinostomus elongatus*)**. Climate change is projected to increase annual thermal averages in freshwater ecosystems, thereby decreasing favourable thermal habitat of coldwater poikilothermic species. To evaluate potential thermal impacts to poikilotherms, it is necessary to understand their thermal capacity to persist in warmer waters. One measure of this capacity is critical thermal maxima (CTmax) - the temperature at which fish lose equilibrium as a function of thermal stress. In this study, we evaluate the thermal tolerance of Redside Dace, an endangered minnow in Canada. We examined seasonal variation in CTmax by conducting monthly streamside experimental trials on a northern population of Redside Dace in Two Tree River, St. Joseph Island. Preliminary results indicate that ambient water temperature positively affects the CTmax of Redside Dace with Redside Dace exhibiting the greatest average CTmax of 33.6°C at warm river temperatures and the lowest average CTmax of 27.5°C at cool river temperatures. Total body length also influenced CTmax, indicating that different life stages may exhibit different vulnerabilities to climate change. This suggests that Redside Dace at the species' northern range may have the ability to adjust their thermal threshold as a function of age and ambient water temperature. Future questions for analysis include whether Redside Dace in southern populations exhibit similar seasonal CTmax trends. (Poster)

Leger, J.* and Simmons, D.B.D. University of Ontario Institute of Technology. **Adaptive responses to hypoxic conditions in blood and plasma proteins sampled from *Oncorhynchus mykiss* in the laboratory**. Oxygen depletion occurs in freshwaters as dissolved oxygen becomes reduced in concentration to a point where it becomes detrimental to aquatic organisms living in the system. An aquatic system with low concentration (e.g. ranging between 1 and 30% saturation) is considered hypoxic. Fish are exposed to hypoxia in deeper waters and during events like algal blooms. The effects of hypoxia on fish include decreased oxygen consumption, reduced feeding, changes in ATP and lipid metabolism pathways, and changes in cellular mitochondria abundance. A handful of studies have examined changes in proteome responses due to hypoxia, but mostly in tissues (liver, gill, heart, brain, skeletal muscle). In the present study, we acclimated rainbow trout (*Oncorhynchus mykiss*) to hypoxic conditions and then sampled blood from the caudal vein 48 hours post-acclimation. Our poster will present changes

in the plasma proteome of rainbow trout and will relate those changes to other observable changes in blood such as blood hematocrit, red blood cell counts, glucose levels, and biological functions. (Poster)

Lehnert, S.J.*; Kess, T.; Bentzen, P; Kent, M.P.; Lien, S.; Clément, M.; Bradbury, I.R. Fisheries and Oceans Canada. **Heterogeneous genomic divergence between European and North American Atlantic salmon (*Salmo salar*) highlights small and large genomic drivers of trans-Atlantic isolation.** Atlantic salmon (*Salmo salar*) is a species of cultural, economic, and ecological significance characterized by highly structured populations across the North Atlantic. Across the range, the deepest phylogenetic division occurred >600,000 years ago between eastern and western Atlantic populations with some support for subspecies status. However, no studies have used high-density genomic data to investigate the magnitude or genomic architecture driving trans-Atlantic isolation. Here, using 220,000 SNPs and 80 populations across the North Atlantic, we found evidence of high (mean $F_{ST}=0.26$) and heterogeneous genomic divergence between European and North American salmon. Genomic regions associated with trans-Atlantic divergence ranged from single loci (SNPs) within key genes (e.g., SHH) to large genomic regions (3Mbp) on two chromosomes (Ssa06 and Ssa13). These two regions showed evidence of selection and were characterized by blocks of high linkage disequilibrium, suggesting a potential role of structural variation in trans-Atlantic differentiation. Functional enrichment of metabolic, immune, and sensory processes in these regions may also highlight differences in pathogen resistance or migration behaviour between continents. Our results provide insight into the deep divergence and genomic architecture underlying differences between European and North American Atlantic salmon and evidence of near fixed and adaptive trans-Atlantic differences supports subspecies designation. (Oral)

Lescord, G.L.*; Johnston, T.A. L. James, B. A. Branfireun, J. M. Gunn. Laurentian University, Sudbury Ontario. **The use of non-traditional oxygen stable isotopes in delineating trophic ecology and mercury bioaccumulation in freshwater fish.** Many ecological studies use carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope (SI) ratios to assess a fish's energy sources and trophic elevation, respectively. In recent laboratory studies, piscine oxygen SIs ($\delta^{18}O$) have been shown to reflect the signature of their surrounding water. This study examined the utility of $\delta^{18}O$ ratios to understand the trophic ecology and mercury (Hg) bioaccumulation in lacustrine fish populations across Ontario. We collected invertebrates and fish (white sucker, lake whitefish, northern pike, walleye) from 4 lakes in northern Ontario; fish were sized and all samples were analyzed for Hg, $\delta^{18}O$, $\delta^{13}C$, $\delta^{15}N$ values. Preliminary results show that, in the two deeper lakes known to stratify, profundal lake whitefish with more offshore carbon signatures also had heavier $\delta^{15}N$, higher [Hg], and heavier $\delta^{18}O$ ratios, potentially due to a heavier signature of the open-water environment. In the shallower lakes, all fish with more littoral-based carbon signatures had lower [Hg] and $\delta^{15}N$ ratios but enriched $\delta^{18}O$, potentially due to the influence of groundwater upwellings visible in the systems. These initial results show that piscine $\delta^{18}O$ data compliment $\delta^{13}C$ data, though baseline data from the invertebrates collected, as well as water samples from similar boreal lakes, are currently being analyzed. (Oral)

Liu, K.*; Schiff, S.L.; Wu, L.; Molot, L.A.; Venkiteswaran, J.; Paterson, M.; Elgood, R.; Tsuji, J.M.; Neufeld, J.D. University of Waterloo. **Iron isotopes reveal novel metabolic pathways for iron cycling in boreal shield lakes.** Harmful algal blooms (HABs) in freshwaters are a significant environmental problem. Recently, Fe was proposed as the controlling factor of the cyanobacteria dominance. Natural abundance Fe isotopes are useful tracers for biogeochemical processes involving Fe. Within boreal shield catchments, we found the range of iron isotopes spanned more than half of the entire range of Earth surface samples. We studied two lakes: eutrophic Lake 227 with experimental fertilization and oligotrophic Lake 442. Within the lakes, two layers with distinct isotope compositions of dissolved and particulate Fe were observed in the water columns. In the oxic surface layer, dissolved $\delta^{56}\text{Fe}$ is more positive than particulates, consistent with dominance by Fe-DOC complexes. In the anoxic lower layer, upward flux from sediments dominates the dissolved Fe pool and redox processes produces isotope fractionation between dissolved and particulate Fe. The observed natural large fractionation of Fe isotopes provides a potential tool to probe acquisition of Fe by cyanobacteria and algae. Furthermore, $\delta^{56}\text{Fe}$ of bulk sediments in L227 clearly records the 50-year experimental fertilization regimes and currently reflects values in POM in the epilimnion, suggesting sediments could record the onset of changes in Fe cycling due to nutrient addition. (Oral)

Loewen, C.J.G.*; Vinebrooke, R.D.; Zurawell, R.W. Department of Ecology & Evolutionary Biology, University of Toronto. **Multiscale drivers of phytoplankton communities and their species' traits.** Separating the various local and regional factors driving species diversity patterns is a persistent challenge of modern ecology. Environmental conditions vary at multiple scales, often leading to spatially-autocorrelated responses that confound interpretation of key ecological processes and anthropogenic disturbance. Further, the composition and structure of communities may change in response to seasonal conditions, leading to environmental associations and trait syndromes that fluctuate across time. Here, we applied a spatially-explicit and data-driven approach to evaluate seasonal changes in phytoplankton community composition across Alberta. Results validate several a priori hypotheses concerning environmental filtering in freshwater lakes and reservoirs; for instance, confirming the pronounced and covarying effects of agricultural land use and nutrient enrichment on taxonomic variation by cyanobacteria. Generally, our findings point to an increasing importance of local over regional factors across the open-water season. By revealing key environmental gradients and their associations with organismal traits across a diverse set of lakes, our work generates new insights into the functional structure of seasonal phytoplankton succession in the north temperate climatic zone. (Oral)

Lulat, N.*; Wilson, C.C; Heath, D.D. Great Lakes Institute for Environmental Research. **Quantitative eDNA assessment of reintroduced Atlantic salmon (*Salmo salar*) in Lake Ontario tributaries using microsatellite markers.** Until the late 1800s, Atlantic salmon (*Salmo salar*) were abundant and part of Lake Ontario's native fish community, now extirpated due to human impacts. Plans to reintroduce a population of Atlantic salmon in Lake Ontario consists of stocking hatchery-reared fish yearly which will help to achieve a self-sustaining population. The issue with reintroduction remains in understanding the distribution of fishes after stocking, thus, it is important to monitor the fate of these fishes. Environmental DNA (eDNA) provides a

sensitive approach for monitoring that can offer inferences into fish distribution. Distribution of fish eDNA may not be only useful for determining presence and absence, but also for abundance. Through the use of alternative molecular markers, eDNA can be used to quantify stocked Atlantic salmon in Lake Ontario tributaries to determine their absolute abundance. Methods include sampling stocked streams and characterizing eDNA to identify Atlantic salmon presence using COI markers. The same eDNA will be used to quantify abundance at positive hit sites using microsatellite markers. Allele counting models will be used to estimate the number of individuals contributing to the eDNA signal. This data will help determine which areas reintroduced Atlantic salmon may concentrate in, indicating preference of habitat. Establishing a self-sustaining population of Atlantic salmon will help restore a native species to Lake Ontario, thus providing a baseline for reintroduction and management of other native species. (Oral)

MacKay, S.E.*, Kirkwood, A.E. University of Ontario Institute of Technology. **The response of colonizing and established communities of periphyton across a land-use gradient in the Lake Simcoe watershed.** It has been estimated that 31% of phosphorus loading to the Lake Simcoe watershed (LSW) originates from urban stormwater and runoff. To understand the periphyton response in urban drainage basins, fourteen tributary sites across the LSW were selected based on Human Activity Gradients in order to classify each site along a land-use gradient of reference-agriculture-urban. During spring, summer, and fall of 2016 and 2017, water quality and the periphyton community were assessed. The focus in 2016 was to assess the response of colonizing periphyton using five landscape pavers that were deployed at each site and collected 21 days later. The focus in 2017 was to assess the response of already established periphyton communities by sampling a minimum of three rocks at each site. Preliminary results show chloride to be greatest at urban sites, and urban nitrogen and phosphorus concentrations are comparable to agriculture sites. The abundance and diversity of periphyton is predicted to be greater for established communities during the summer. Determining the relative importance of land-use type, season, and community age on periphyton community composition and abundance will assist watershed managers in mitigating the impacts of urban land-use development. (Oral)

Mackereth, R.W.*, Smith, A. Centre for Northern Forest Ecosystem Research, Ontario Ministry of Natural Resources and Forestry, Canada. **Landscape factors influencing stream temperature and brook trout distribution in Boreal streams.** Summer surface water temperature in boreal streams can exceed the thermal tolerance for brook trout (*Salvelinus fontinalis*) indicating that areas of thermal refugia are required for these populations to persist. We examined the influence of spatial and temporal thermal variability in streambed temperature on the distribution of brook trout. In the summer, streambed temperatures within a reach varied spatially as much as 12 °C with the cold temperatures, associated with lateral groundwater inputs from the terrestrial riparian area, driving the variability. Streambed temperature loggers showed that locations with groundwater inputs had significantly less diurnal temperature variation and were significantly cooler in the summer (Jun-Oct) and warmer in the winter (Nov-Apr) relative to other areas in the stream. Electrofishing and underwater video surveys indicated that brook trout occupation of areas with cool water inputs was significantly greater than other locations when stream surface water exceeded the optimal thermal level. To help

protect critical brook trout habitat we have developed GIS-based models to predict the location of terrestrial-aquatic linkage areas associated with temperature variability. These models are used to help plan for protection of terrestrial-aquatic linkages during forest management operations and plan for conservation efforts to mitigate potential impacts of climate change. (Oral)

Macnaughton, C.J.*; Durhack, T.D.; Charles, C.; Kovachik, C.; Mochnacz, N.; Enders E.C. Freshwater Institute, Fisheries and Oceans Canada. **Thermal behaviour and metabolic performance of the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) across temperatures.** In the field, preferred temperatures (T_{pref}) for Westslope Cutthroat Trout (WCT) are thought to range from 9-12 °C and the species' preference for cooler water temperatures has been shown to drive their occupancy in cooler headwater streams where physiological demands are decreased. Previous lab studies have also suggested that WCT prefer temperatures around 15 °C and that WCT perform better at colder water temperatures. Using shuttlebox experiments, we showed that average daytime temperature preference for juvenile WCT was substantially higher at 18.6 °C, with occupied temperatures ranging between 12 °C and 26 °C throughout the duration of trials. Moreover, intermittent-flow respirometry experiments demonstrated that metabolic performance (aerobic scope) significantly increased with temperature, reaching an optimum between 15 and 20 °C, beyond which, it decreased substantially and lethal temperatures occurred around 25 °C. These results collectively suggest that juvenile WCT may tolerate and even prefer warmer water temperatures on account of their optimal metabolic performance at warmer water temperatures. Through controlled physiological experiments, we aim to enhance our knowledge of the functional ecology of WCT and improve the conservation and management planning of the species throughout its distribution in Alberta, where it is listed as threatened. (Oral)

Madison, B.N.; Halliwell, L.; Reynolds, J.; Leshuk, T.; Gu, F.; Peru, K.M.; Headley, J.V.; Orihel, D.M. (1School of Environmental Studies, Queen's University; 2Department of Chemical Engineering and the Waterloo Institute for Nanotechnology, University of Waterloo; 3Science & Technology Branch, Environment and Climate Change Canada). **Assessing the effects of TiO₂-treated oil sands wastewater exposure on developing fathead minnows (*Pimephales promelas*).** Naphthenic acids (NAs) are common toxic components of oil sands process affected water (OSPW) that reach concentrations in tailings ponds known to be lethal to aquatic animals. The mitigation of NA toxicity is imperative to OSPW management, but current storage options pose risk of release into the environment and existing detoxification treatment options are limited. We examined the effects of a novel photocatalytic method; using TiO₂-coated buoyant microparticles, to reduce the toxicity of NA-fraction components (NAFC) from OSPW to developing fathead minnows (FHM). Experiments assessing the toxicity to developing FHM were performed using commercial NAs and OSPW-NAFC in both controlled laboratory- and an outdoor semi-natural setting. Increased treatment intensity (duration of photocatalysis) resulted in the greater removal of acid-extractable organic (AEO) compounds in exposure waters. This resulted in the abolition of NA toxicity in exposure waters that were at acutely lethal (<24h) concentrations prior to the treatment with the photocatalytic process. The photocatalytic treatment was more effective at reducing the toxicity of NAFC from OSPW to

those treatments containing commercial NAs. Comparable effects were observed in our semi-natural setting. This study provides the groundwork for large-scaled ecotoxicological testing of the use of this photocatalytic treatment of OSPW in semi-natural mesocosms. (Oral)

Mahdiyan, O.*; Molot, L.; Sapna, S. York University, Canada. **Drivers of water quality changes in North American lakes over the past 40 years.** Freshwater lakes in North America are continuously subjected to multiple stressors which may impair water quality, including climate change, nutrient loading, lake productivity, land use development, and brownification. This study incorporates time series data (1976-2017) for 79 lakes across North America. We evaluated trends in physical (water temperature and secchi depth), chemical (phosphorus, nitrogen, dissolved organic carbon, and chloride), biological (chlorophyll), and climatic (temperature, precipitation, and cloud cover) variables using Sen's slope models for each lake. Generally across lakes over the past 40 years, lake phosphorus has significantly declined, whereas dissolved organic carbon has increased, and chlorophyll has become increasingly variable year to year. In addition, lake water temperatures have become significantly warmer, potentially reducing the amount of cooler water habitat for sensitive aquatic life. Future work will include regression tree analyses to examine the potential drivers of chlorophyll concentrations (a proxy for water quality). As freshwater resources are becoming increasingly threatened worldwide, maintaining their integrity has emerged as a key global issue with far-reaching consequences for human and ecosystem health. Identifying the drivers that are most damaging to the water quality of North American lakes is an important first step in developing meaningful targets for future management strategies. (Oral)

Malley, B.K.*; Moore, J-S.; Harris, L.N.; Roth, J.D.; Tallman, R.F. University of Manitoba. **Freshwater movements of anadromous Arctic Charr (*Salvelinus alpinus*) revealed by passive acoustic telemetry.** Arctic Charr are distributed across the Canadian Arctic, including Victoria Island, Nunavut. For millennia they have been a critically important resource for Inuit in the Cambridge Bay area, especially the anadromous variant which entirely supports the subsistence and commercial fisheries. For the past 50 years, the management of Arctic Charr has relied primarily on analysis of trends in biological characteristics. Recently, the integration of population genetics and marine acoustic telemetry has advanced our understanding. However, a knowledge gap of the freshwater portion of their life cycle remains. Objectives of this study are to determine (1) where Arctic Charr overwinter, (2) their winter movement activity level, (3) the timing of migrations within freshwater environments, and (4) the environmental and biological drivers that impact these. To address these unknowns, 347 anadromous Arctic Charr were surgically implanted with acoustic transmitters between 2013 and 2017 to be used in combination with an acoustic array. Our results will further the understanding of the migratory behavior of anadromous Arctic Char including the timing and location of key life history events. Undoubtedly aiding in accurately managing and conserving this highly valued, ecologically complex species that will ultimately be faced with the rapid changes anticipated for the Arctic. (Poster)

Matte, J.-M.; Fraser, D.J.; Grant, J.W.A. Concordia University. **Intraspecific variation of density-dependent growth and mortality among three neighbouring populations of a stream fish.**

Little is known of the mechanisms driving density-dependence. Increases in animal density have been observed to reduce individual growth, increase mortality, or both. However, their relative importance and the shape of these relationships varies across studies, but it is unclear whether this is from intraspecific, interspecific or methodological differences. Understanding why these differences occur across systems is critical to population ecology, and to the development of conservation guidelines. For this purpose, we manipulated the density of young-of-the-year brook trout in small sections of three neighboring streams in Cape Race, Newfoundland. This experiment was conducted over a large density gradient (0.3-7 fish/m²) in a natural setting, with spatial (3 sites per stream) and temporal (three consecutive years) replication. We detected temporally consistent intraspecific variation in the shape of density-dependent growth across three neighbouring populations (negative exponential, density-independent and negative logarithmic, respectively), but not for mortality (positive logarithmic only). Density-dependence was strongest in the population for which growth was density-independent, hinting at different tradeoffs across populations. This work demonstrates that intraspecific variation can drastically alter density-dependent relationships even in neighbouring populations experiencing similar climactic conditions, and that the extent of this variation mirrors that of the literature on density-dependence. (Oral)

McKenzie, M.*; Jones, N.E. Trent University, Canada; Ontario Ministry of Natural Resources.

Spatial patterns of stable isotope ratios of C and N in Great Lake tributaries: The influence of resource subsidies and fragmentation. Thousands of sport fish migrate yearly out of the Great Lakes and into the surrounding rivers to spawn transporting large quantities of nutrients in the form of eggs and excrement. These nutrients potentially increase stream productivity and the abundance of invertebrates and juvenile lake fish. Greater research is required to understand how subsidies influence stream productivity and how this process varies across the landscape, including in streams fragmented by barriers. We compared stable isotopes of carbon and nitrogen in stream fish and benthic invertebrates from either side of barriers across 37 Great Lake tributaries to identify individuals that consumed and benefited from a subsidy. Variation in stable isotopes across the Great Lakes suggests stream characteristics may impact resource subsidies and their ability to benefit stream productivity. This research highlights the loss of productivity in reaches upstream of barriers to fish movement, as they restrict a process that plays a significant role in promoting productive streams that yield populations of lake fish. (Oral)

McLean, M.F.*; Litvak, M.K.; Cooke, S.J.; Hanson, K.C.; Patterson, D.A.; Hinch, S.G.; Crossin, G.T. Dalhousie University. **Immediate behavioral and physiological response from catch-and-release of wild white sturgeon (*Acipenser transmontanus*).** White sturgeon (*Acipenser transmontanus*) are the largest freshwater fish in North America with the largest population in Canada occurring in the lower Fraser River (LFR), British Columbia. The LFR is a highly populated and industrialized area where habitat degradation and anthropogenic interactions are of concern for wild fish populations. White sturgeon life-history traits like long lifespans, late age of maturity, and long intermittent spawning intervals, make them sensitive to impacts on their survival and reproductive capacity. There are large knowledge gaps pertaining to white sturgeon basic biology in their natural habitat, and an understanding of the effects of

anthropogenic activities on their physiological state and behaviour are largely unknown. We used tri-axial accelerometers to assess post-release locomotor behaviour of white sturgeon after release from angling within the LFR. Captured sturgeon (n=63) had blood samples taken to assess the physiological stress response, and seven were fitted with acoustic transmitters equipped with accelerometer sensors. To understand the relationship between accelerometry and fish behaviour, we calibrated the tags in a lab before deploying them in the field. This is the first study to quantify short-term locomotor activity in wild sturgeon using accelerometer transmitters and link variation in behaviour to physiological state. (Oral)

McMeans, B.C.*, Fernandes, T. University of Toronto Mississauga. **Coping with the cold: the winter ecology of freshwater fishes.** Winter data are incredibly rare for freshwater fishes and their food webs. This is problematic because winters are becoming warmer and wetter across much of Ontario. Warmer winters could directly impact fish that are unable to respond to changing climate conditions. Altered species interactions and food web structures could also have cascading effects on many fish species. I will present preliminary findings of several ongoing studies focused on the physiology and behavior of freshwater fishes under current winter conditions. We are finding that energy storage and conservation strategies correlate with winter behavior in fish belonging to different thermal guilds (e.g. cold vs. warm). These differential responses to winter have consequences for community and food webs structure and the functioning of whole ecosystems, and shed new light on a poorly studied time of the year. (Oral)

Mead, J.L.*; Venkiteswaran, J.J.; Elgood, R.J.; Schiff, S.L. University of Waterloo. **The role of Fe in the photodegradation of dissolved organic carbon in boreal lakes.** Dissolved organic carbon (DOC) is the largest input of carbon to northern shield lakes but retention of DOC within lakes is large. Photodegradation of DOC is an important abiotic process for DOC loss and likely sediment formation. Products of DOC photodegradation including particulate organic carbon (POC), dissolved inorganic carbon (DIC), and photolytically altered DOC, affect the size of carbon pools in lakes. Concomitantly, lake parameters such as Fe concentrations can influence the rates of carbon transformation, yet these influences are poorly understood. Stable isotope analysis has been used to provide insight into the fate of allochthonous DOC and the accumulation of POC in lake sediments. In laboratory experiments, Fe concentrations of two boreal streams from the Experimental Lakes Area, Kenora, ON were manipulated to observe the impact on DOC photodegradation and POC formation. Measures of DOC quality (absorbance and fluorescence) were used to identify changes in DOC composition resulting from photodegradation. Changes in $^{13}\text{C}/^{12}\text{C}$ of DOC, DIC, and CO_2 were measured throughout the experiment. Measurement of carbon pools during photolysis allowed the determination of carbon and isotopic mass balances. The data will provide insight into the mechanisms controlling the partitioning of terrestrial carbon between the atmosphere and lake sediments. (Oral)

Melles, S.J.*, Chu, C., Jones, N.E., Schmidt, B. Ryerson University. **Freshwater Aquatic Ecosystem Classification in Ontario and Beyond: Room for Conservation.** Conservation and management of fresh flowing waters involves evaluating and managing effects of cumulative impacts on the aquatic environment from disturbances such as: land use change, point and

nonpoint source pollution, the creation of dams and reservoirs, mining, and fishing. To assess effects of these changes on associated biotic communities it is necessary to monitor and report on the status of lotic ecosystems. A variety of stream classification methods are available to assist with these tasks, and such methods attempt to provide a systematic approach to modeling and understanding complex aquatic systems at various spatial and temporal scales. Three main approaches group create aquatic ecosystem classes based on 1) longitudinal patterns; 2) regionalized catchment groupings; 3) a-spatial environmental similarities. This talk will revisit a proposed eight-step heuristic process for Ontario and examine progress toward creating an integrated and flexible aquatic classification based on the current understanding, network thinking, and theoretical underpinnings. How far are we from conservation? (Oral)

Melles, S.J.*; Oswald, C.; Ash, C. Ryerson University. **Identifying seasonal road salt hotspots in three urban and urbanizing stream networks.** Identifying ways to minimize damage of road salt pollutants entering our waterways requires a detailed understanding of not only where and when excess road-salt gets into streams, but also which type of streams are most sensitive to salt damage. Given the directional nature of river networks, upstream systems have smaller catchments and aggregate fewer pollutants than downstream systems, but they may also be more sensitive to damage because of their smaller watercourse size and reduced dilutive capacity. Spatial Stream Network (SSN) models are a geostatistical (interpolation and mapping) tool that can help identify chloride “hotspots” within river networks. We performed high spatial resolution longitudinal surveys in three urban and urbanizing watersheds on a quarterly basis (spring, summer, fall, winter) to determine how in-stream chloride concentrations change in time and space. Electrical conductivity (EC) was used as a proxy for chloride concentration, and manual grab samples were used to verify the relationship between EC and chloride. These geospatial models use flow-connected relationships to improve predictive ability. This talk will discuss the potential to use SSN models from a multiscale perspective, where scale is defined as a function of catchment size and stream order. (Oral)

Meyer-Jacob, C.*, Labaj, A.L., Paterson, A.M., Michelutti, N., Cumming, B.F., Keller, W., Smol, J.P. Paleocological Environmental Assessment and Research Laboratory, Department of Biology, Queen’s University, Kingston, Ontario. **Are lakes browning or re-browning? Impact of atmospheric deposition and climate change on long-term lake-water organic carbon levels in Ontario lakes.** Over the past decades, organic carbon (OC) levels have increased in many lakes (i.e., “lake browning”) across Europe and NE North America. Identified drivers for this increase include reduced acid deposition, land-use/cover changes, and climate change, yet the specific contributions of each these drivers are still debated. Here, we present sediment-inferred lake-water OC trends for Ontario lakes, from low to high acid deposition regions, over the past ~200 years. Our results show that in lakes near Sudbury, northeastern Ontario - an area that has been heavily affected by acid deposition - OC concentrations declined by ~50% compared to pre-industrial levels. After SO₂ emission reductions occurred in the 1970s, OC concentrations started to slowly recover, but still remained ~30% below pre-industrial values by the 2000s. In contrast, in lakes of the low deposition Experimental Lakes Area of northwestern Ontario, OC values declined by only ~10% during the early 20th century and exceeded pre-industrial values by the 1970s (~10% relative increase by the 2000s), likely in response to climate change. Our

findings demonstrate the widespread “re-browning” of lakes in former high acid deposition regions, and suggest that OC levels will exceed pre-industrial values with complete recovery from acidification in response to ongoing climate change. (Oral)

Midwood, J.D., Boston, C. Fisheries and Oceans Canada. **Assessment of the precision a fish index of biotic integrity for evaluating ecosystem condition.** Indices of biotic integrity (IBI) are frequently applied to provide a simple but accurate measure of the condition of biotic communities and habitats. These indices typically rely on sub-metrics that are derived from field surveys of the biotic community and, as such, final IBI scores are influenced by sampling variability that is inherent to any survey effort. Quantifying this variability is critical for fully utilizing IBI to compare community or habitat condition spatially or temporally. Here, the variability of a fish-based IBI was determined by bootstrapping estimates of the IBI score from a series of over-sampled embayments and open coasts regions of Lake Ontario. Changes between 14-16 IBI points were beyond what might be expected due to sampling variability and consequently represent ecologically significant changes in the IBI score. Estimates were on the lower end of this range for embayments (13.8), but appear to be higher for open coast sites. Several short case studies will be presented to illustrate the utility of IBI precision for enhancing our interpretation of the trends in long-term IBI datasets and setting targets for habitat enhancement or offsetting projects. (Poster)

Milling, A.*, Rennie, M.D., Paterson, M.J. Lakehead University. **Changes to the zooplankton community in response to the removal of *Mysis diluviana* from an Ontario lake.** *Mysis diluviana* are an omnivorous freshwater zooplankton predator capable of drastically impacting aquatic communities. The omnivorous feeding behaviour integrates pelagic and profundal energy channels and allows *Mysis* to play a key role in transferring energy from lower trophic levels. *Mysis* serve as a critical prey source for lake trout (*Salvelinus namaycush*) during the transition from a planktivorous to a piscivorous diet. While there are many examples of *Mysis* introductions that attempted to boost salmonid fish production, there are few studies that examine the removal of *Mysis*. Through the results of a whole-lake acidification experiment done at the Experimental Lakes Area (ELA), I compare the zooplankton community composition of a lake before and after the extirpation of a keystone zooplankton species, *Mysis diluviana*. I use historical data to look at species compositional shifts in the zooplankton community. Biomass estimates of *Mysis* and *Chaoborus* sp. are used to estimate functional group redundancy. Community importance is calculated to quantifiably determine if *Mysis* serves as a keystone species in this lake ecosystem. MANOVA results suggest that the zooplankton community composition is significantly different with *Mysis* absent from the community. (Oral)

Moir, K.E.*; Cumming, B.F. Queen's University. **Parsing out the influence of climate: What is driving recent cyanobacterial growth in the St. Lawrence River?** Recent research on the St. Lawrence River (SLR) suggests that there has been a substantial increase in cyanobacterial biomass in some areas over the past 15 years, a concerning trend potentially driven by a variety of factors, including high nutrient concentrations. However, several recent studies in temperate areas have suggested that climate change may be driving cyanobacterial growth. Disentangling these stressors is important to effectively direct management options in the SLR, which has

experienced eutrophication issues for several decades. In the SLR, sites are exposed to different local stressors depending on the surrounding land use, position in the river, and historical activities in the area. Simultaneously, the entirety of the SLR is subjected to the same global and regional stressors (e.g., climate change). By strategically selecting locations, a range of sites can be obtained that are exposed to varying intensities of different environmental stressors, a historical record of which can be examined using paleolimnological techniques. This study will examine how multiple stressors affect algal growth and community composition in the SLR, to clarify which factors are driving recent increases in cyanobacterial abundance. Understanding how these stressors interact will enhance our understanding of climate-change impacts on large river ecosystems. (Oral)

Mokdad, A.I.*; Garner, S.R., Neff, B.D., Pitcher, T.E. Great Lakes Institute for Environmental Research - University of Windsor. **Effects of Hard and Soft Release on Post-Release Performance of Atlantic Salmon (*Salmo salar*)**. The success of reintroduction programs relies, in part, on the post-release behavioural performance of individuals. Traditional hatchery release practices involve transporting fish several hours to be released directly into the body of water being stocked - referred to as “hard release”. In contrast, “soft release” refers to the practice of providing translocated animals an acclimation period at the site prior to release. Soft release enables animals to recover from highly stressful transport and acclimate to environmental conditions. Here we test the hypothesis that post-release performance (movement behaviour, growth rate, and survival) of Atlantic salmon fall fingerlings differs between hard and soft release groups released into a tributary of Lake Ontario. Approximately three hundred fall fingerlings were transported to Duffins Creek and allowed to acclimate for 6 days prior to release - the soft release group. The hard release group were transported from their home tanks and released, simultaneously with the soft release group, directly into the creek. We monitored movement of these fish using passive integrated transponder tags and corresponding arrays, followed by recapture efforts to estimate growth rate and survival. The results from this study will be discussed in the context of the relationship between behavioural plasticity and fisheries reintroduction practices. (Poster)

Molot, L.A.*, S.L. Schiff, J.J. Venkiteswaran, H.M. Baulch, S.N. Higgins, A. Zastepa, M.J. Verschoor, D. Walters. York University. **Guiding principles for preventing cyanobacteria blooms in a changing climate: Integrating nutrient limitation and sediment redox science into watershed management**. Cyanobacteria bloom management has empirically relied on total phosphorus (TP) removal to lower productivity with only an incomplete understanding of how increasing TP increase the risk of bloom formation. Our research has identified four important scientific principles highly relevant to cyanobacteria bloom management and based on these principles, formulates a hierarchy of watershed management and in situ treatment guidelines for choosing options to prevent or mitigate blooms. The principles synthesize our understanding of how nutrients (phosphorus (P), nitrogen (N), iron (Fe) and other metal cofactors) and sediment anoxia interact to promote and maintain cyanobacteria blooms in warm waters, they suggest ways of improving nutrient targets, watershed management and in situ treatment methods, and they provide some insight into why a warming climate has rendered older P targets less effective. These principles lead to a logical hierarchy of

management options aimed at maintaining a relatively oxidizing environment at the sediment/water boundary. (Oral)

Montgomery, F.*; Minns, K.; Reid, S.; Mandrak, N.E. University of Toronto Scarborough. **An evaluation of single-species and community-based approaches to assess impacts of habitat alteration on fishes and fish habitat.** To identify impacts of habitat alteration on fishes and fish habitat, impact-assessment tools use single-species and community approaches depending on the socio-economic and ecological objectives. The goals of this study are to evaluate if the outputs from these approaches are sensitive to spatial data availability and if the subsequent science advice provided to management differs depending on the approach used. We compared two impact-assessment tools: 1) a single-species model (Montgomery et al. 2018); and, 2) a community model (Habitat Ecosystem Assessment Tool) (Minns 2010). The single-species model was derived from empirical species-habitat relationships for the Endangered Pugnose Shiner, *Notropis anogenus*. HEAT is a modelling tool used to assess changes in fish habitat productivity and is based on database-derived species-habitat relationships. Using an empirical example of proposed drain maintenance in a Lake St. Clair tributary, we compared the weighted suitable area (WSA) after maintenance weighted for Pugnose Shiner only, for at-risk fishes only, for all species present, and for all possible fish groups. Preliminary results indicate that impacts of maintenance to fish habitat (net loss of WSA) are much larger with a single-species approach. We evaluated variation in WSA across different spatial resolutions in ArcMap and qualitatively compared resultant science advice between approaches. (Oral)

Morbey, Y.E. Western University. **Sexual selection and the evolution of sexual size dimorphism in lake whitefish.** Lake whitefish (*Coregonus clupeaformis*) exemplify a long-lived freshwater fish species with indeterminate von Bertalanffy type growth and extensive among-population variation in age and size at maturity. Patterns of life history variation generally follow expectations from classic life history theory. An under-appreciated extension of life history theory considers sex-specific fitness functions. According to sex-specific optimization models, female-biased sexual size dimorphism (SSD) can evolve due to sexual selection favouring earlier maturation by males, even when sexes are otherwise similar in their growth and mortality regimes. The magnitude of SSD is expected to depend on mortality rate. When mortality rates are low, both males and females are expected to mature at older ages and larger sizes, closer to asymptotic size, thus reducing SSD. The predicted relationship between the magnitude of female-biased SSD in age and size at maturity and mortality rate was tested in a comparative analysis of lake whitefish (*Coregonus clupeaformis*) from 26 populations across a broad latitudinal range in North America. As predicted, female-biased SSD was less extreme among lower mortality, high latitude populations. (Oral)

Moslemi-Aqdam, M.*; Abdolmalaki, Sh.; Swanson, H.K. University of Waterloo. **Sex ratio of Northern Pike (*Esox lucius*) in Anzali Wetland, SW Caspian Sea.** Northern Pike (*Esox lucius*) support important commercial and subsistence fisheries in the Anzali Wetland, Caspian Sea. The Anzali Wetland receives wastewater effluent and urban sewage from multiple adjunct rivers, and concerns have been raised regarding possible intersex in Northern Pike exposed to endocrine-disrupting chemicals. As an important preliminary first step, we assessed whether

sex ratios were skewed. Using 433 Northern Pike collected monthly from a commercial gill net fishery (2.5-12.5 cm stretched mesh size) from July 2012 to June 2013, we found that the overall sex ratio (M:F) was 1:1.6 and differed statistically from 1:1 sex ratio ($\chi^2 = 5.760$, $df = 1$, $p = 0.016$). Analyses conducted at finer temporal scales showed, however, that the sex ratio did not differ significantly from 1:1 between the months of December to February, which is the spawning season. We conclude that the observed female bias in annual catch data is likely due to their larger size, and thus higher vulnerability to commercial fishing gear, and that intersex is not likely a problem in this population. The larger number of males captured during the spawning season likely reflects higher catchability that results from changes in behavior during spawning. (Poster)

Mozzon, C., J. Montgomery, G.L. Lescord*, T.A. Johnston. Laurentian University, Sudbury Ontario Canada. **The trophic niche of sculpins (*Cottus* sp.) in boreal lakes.** The trophic niche, an organism's functional role as a consumer in an ecosystem, is an important concept in ecological research studying species interactions and habitat use. We examined the trophic niche of freshwater sculpins (*Cottus* sp.), a poorly-studied group of benthic forage fishes that are widespread across Canada. Our main objective was to compare the trophic niches of sculpins and other co-habiting forage fishes in 13 lakes of two regions of Ontario: the Near North (45°00' to 47°30'N), where lakes were deeper, oligotrophic, and contained the piscivorous lake trout, and the Far North (51°10' to 52°20'N), where lakes were shallower, mesotrophic, and contained northern pike and/or walleye. Four trophic niche metrics were determined for each sculpin population based on stable carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) isotope ratios measured in each fish. In the Near North lakes, sculpins exhibited an enriched $\delta^{13}\text{C}$ and higher $\delta^{15}\text{N}$ signature, indicating offshore feeding and higher trophic elevation, as well as larger niches with greater separation from other co-habiting forage fishes. Conversely, Far North sculpins exhibited similar trophic niche metrics to the other forage fishes. Overall, this research will provide new information on lower-end food web structure and sculpin ecology in northern lakes. (Poster)

Muir, C.A.*; Wise, R. A.; Damjanovski, S.; and Neff, B.D. Western University. **The effect of elevated rearing temperature on thermal performance and cardiorespiratory morphology in Atlantic salmon (*Salmo salar*).** The tolerance of Atlantic salmon (*Salmo salar*) to high temperatures is limited in part by the capacity of the cardiorespiratory system to deliver oxygenated blood to tissues. In this study, phenotypic plasticity in cardiorespiratory function was assessed in Atlantic salmon that were reared at either low (+0°C) or high temperatures (+4°C) from fertilization. When salmon reached the parr stage, we used a Doppler flow velocity system to measure maximum heart rate and atrioventricular blood flow velocity across a range of experimental temperatures. We found that developmental temperature was positively associated with the optimal temperature for cardiorespiratory function. Increased developmental temperatures also enabled normal cardiac function to be maintained at higher temperatures before the onset of cardiac arrhythmias. To investigate a potential mechanism for the observed differences, heart morphology (ventricle size, compact myocardium thickness) and gill morphology (functional surface area for gas exchange) are now being examined via histology. Given that the average global temperature is predicted to rise by up to 4°C within the

century, it is increasingly important to understand the effects of elevated environmental temperature on the cardiorespiratory system of salmonids. I conclude by discussing these data within the context of climate change and Atlantic salmon conservation in Lake Ontario. (Oral)

Munaweera, I.*; Muthukumarana, S.; Gillis, D. M.; Watkinson, D. A.; Charles, C. University of Manitoba. **Assessing Lake Winnipeg Basin walleye fish movement patterns.** The “Lake Winnipeg Basin Fish Movement Project”, being conducted by Fisheries and Oceans Canada, is a large-scale, long-term tagging project in the Lake Winnipeg basin. Our study is based on their fish position dataset consisting of detection records from tagged fish (Walleyes) which were collected using a grid of acoustic receivers laid in the bottom of Lake Winnipeg. We will assess Walleye fish movement patterns employing broad summaries and individual movement reconstruction. First, we will use descriptive and exploratory data analysis methods to study the fish behavior by spatial factors (such as initial released point), seasonal effects (such as spawning and post spawning). We will also see if there are distinct behavioural types (e.g. low and high movement individuals). In this study, the true fish positions are unobserved, we only have the positions of the acoustic receivers detecting them. Hence as the final step, we will use the Bayesian State-space modeling approach to estimate the true fish movement model (process model) by combining it with the observation model describing fish detections. (Poster)

Murdoch, A.* Sharma, S. York University. **Cumulative land use effects on boreal fish communities in a changing climate.** The degradation of freshwater environments is often attributed to numerous small impacts that alone may have no measurable effect, but in combination may produce devastating consequences for ecosystems. In addition, it is unknown if the increasing threat of climate change will act to either buffer or enhance concurrent land use effects on fish communities. We investigated potential cumulative land use effects and climate interactions on boreal stream fish communities from over 900 catchments across northern Alberta. Electrofishing survey data were obtained from Alberta’s FWMIS database and were used to calculate fish community metrics. Linear disturbance and polygonal land use data were extracted at local and network catchment scales from the extensive Boreal Ecosystem Anthropogenic Disturbance Dataset. Species richness was greater in warmer regions and declined when cumulative catchment land use exceeded 40% ($R^2 = 0.5$). Total catch per unit effort and the proportion of lithophilic spawning species were lower in catchments with high local land use, and these trends were amplified in warmer regions ($R^2 = 0.6$). This study provides empirical evidence for combined land use and climate effects in the increasingly threatened boreal region of North America. (Oral)

Musetta-Lambert, J.L.*; Muto, E.A.; Kreutzweiser, D.P.; Sibley, P.K. University of Guelph. **Long-term effects of wildfire in boreal headwater catchments on riparian-stream linkages: implications for forest management.** Applying the emerging paradigm of emulation of natural disturbances (END) to forest management requires understanding of how the riparian-aquatic interface responds to natural forest disturbances. A comparison of riparian forest-derived subsidies, stream function, and structure was conducted across boreal, headwater streams with wildfire, harvest with minimum 30 m buffers, and reference forested catchment histories. We assessed riparian vegetation characteristics, leaf litter and terrestrial invertebrate subsidies,

instream leaf litter decomposition dynamics, and aquatic macroinvertebrates found in leaf packs and drift. Riparian forest community structure was significantly more taxonomically rich at fire than reference sites and accounted for significantly greater and compositionally dissimilar leaf litter subsidies to streams. Although decomposition in the leaf packs did not differ significantly among disturbances, the aquatic invertebrate communities found in leaf packs at fire sites were characterized by higher taxa richness and unique shredder taxa. Significantly greater biomass and compositionally different communities of aquatic macroinvertebrates were found in drift in fire-disturbed streams. Differences in riparian and instream ecological structure suggest that forest management under the END paradigm could sustain ecosystem services and provide increased energy subsidies for instream foodwebs by inducing riparian forest succession and promoting habitat complexity, enhancing leaf litter inputs and organic matter processing. (Oral)

Mushet, G. R.*; Laird, K. R.; Leavitt, P. R.; Cumming, B. F. Queen's University. **Paleolimnological assessment of nutrient and predation controls on cladoceran abundance and composition in four small fisheries lakes, interior British Columbia.** In aquatic food webs, size-selective predation predicts that planktivorous fish will selectively feed on larger microcrustacean zooplankton, thereby providing an advantage to species of small body-size. This has been demonstrated numerous times, particularly in remote, naturally fishless and oligotrophic lakes that were stocked in the 1900's. However, in high-use angling lakes that have experienced nutrient enrichment due to human activity, it is difficult to predict the relative importance of bottom-up and top-down controls on zooplankton communities. To investigate this, we analyzed sub-fossil diatoms, algal pigments, and Cladocera in dated sediment cores from four small fisheries lakes in interior British Columbia. We hypothesized that cladoceran communities in the two lakes that were fishless prior to stocking in the mid 1900's would be more sensitive to changes in size structure due to planktivory, while the two lakes which contained native fish species prior to stocking would be more sensitive to enhanced nutrient loading. Our results show that nutrient enrichment that enhanced algal production has been the paramount process in controlling cladoceran abundance and composition in all study lakes over the past 100 years. (Oral)

Mychek-Londer J.G.*, Venney C. J., and Heath, D. D. Great Lakes Institute for Environmental Research (GLIER), University of Windsor. **Metabarcoding of native and invasive prey in stomach content DNA (scDNA) of commercially harvested Lake Erie fishes.** Aquatic invasive species (AIS) pose serious threats to native biodiversity. To characterize AIS prey in predator diet stomach content DNA (scDNA) we used metabarcoding. We targeted five invertebrate AIS and two native and three non-native fish prey in scDNA from four commercially harvested Lake Erie predator fishes: walleye (*Sander vitreus*), white bass (*Morone chrysops*), white perch (*Morone americana*), and yellow perch (*Perca flavescens*). Invertebrate AIS *Bythotrephes longimanus*, *Cercopagis pengoi*, *Hemimysis anomala*, *Dreissena polymorpha*, and *Dreissena rostriformis bugensis* were targeted using taxa-specific PCR primer sets. A recently designed universal PCR primer set targeted channel catfish (*Ictalurus punctatus*), emerald shiner (*Notropis atherinoides*), gizzard shad (*Dorosoma cepedianum*), rainbow smelt (*Osmerus mordax*), and round goby (*Neogobius melanostomus*) prey. Three of five invertebrate AIS and

all fish prey species were identified in scDNA, while *Dreissena polymorpha* and *Hemimysis anomala* were not. Generalized Linear Models (GLMs) tested predator species, predator size, season (spring, summer, fall), and year effects on prey occurrences and revealed patterns of significance for independent variables which varied according to prey species and respective GLMs. Results confirmed that metabarcoding of scDNA is a highly sensitive approach that can help manage AIS impacts and understand their interactions with Western Basin Lake Erie predator fishes. (Oral)

Naman, S.M.* , Rosenfeld, J.S., Neuswanger, J.R., Eaton, B.C., Enders, E. University of British Columbia. **Comparing bioenergetic vs. correlative habitat suitability models for stream salmonids.** Evaluating fish habitat suitability is crucial for navigating trade-offs between human water use and fish production. Current approaches generally use correlative statistical models based on measured habitat preferences (use relative to availability) for a target species. While these models range in statistical rigour, they continue to be criticized on the grounds that habitat preference is often a poor indicator of the fitness consequences of habitat use. For drift-feeding salmonids, bioenergetic foraging models that link hydraulic conditions and prey abundance to a fish's energy balance offer an alternative suitability metric, which mechanistically links habitat to a more direct correlate of fitness. However, while bioenergetics models show promise, they lack rigorous empirical validation and it remains uncertain whether bioenergetics vs. frequency based approaches differ in their predictive ability. Here, we evaluate the ability of correlative vs. bioenergetic habitat suitability models to predict density and growth of juvenile salmonids (rainbow and cutthroat trout) in B.C. streams. We also describe the development of user-friendly software to generate bioenergetic habitat suitability indices for broader application. Generally, bioenergetic models outperformed correlative ones, suggesting they provide a more rigorous method to predict salmonid responses to altered habitat and flow. However, caveats associated with model parameterization remain. (Oral)

Neary, L. K.* , Remmer, C.R., Klemm, W.K., Kay, M.L., Wolfe, B.B., Hall, R.I. University of Waterloo. **Determining major influences on carbon balance of shallow northern floodplain lakes (Peace-Athabasca Delta, Alberta).** The Peace-Athabasca Delta (PAD) is a dynamic floodplain landscape located in northeastern Alberta, where numerous shallow lakes are reliant on river floodwater to maintain water levels. Lake water levels have declined in recent decades, but the effect of shifting hydrological conditions on lake carbon balances remains unknown. Using pH, CO₂ saturation and stable carbon isotopes in the dissolved inorganic carbon (DIC), we assess the carbon balance of 62 lakes in the PAD during the ice-free season of 2018 following widespread spring flooding. Results identify hydrological processes (evaporation, flooding) and aquatic productivity as two main influences on lake carbon balance. During mid-summer, evaporation and in-lake productivity lead to high pH, under-saturation of CO₂, and low $\delta^{13}\text{C-DIC}$. These patterns are consistent with strong kinetic carbon isotope fractionation that occurs during chemically-enhanced CO₂ invasion. Flooding had noticeable effects on carbon isotope composition of DIC during May, but did not have lasting effects throughout the summer season, since numerous flooded and not-flooded lakes experienced similar conditions of atmospheric CO₂ drawdown. Results highlight the dynamic and heterogeneous lake carbon balances present

in the PAD and generate new knowledge about the effects of hydrological and biological processes on shallow lake carbon balances. (Oral)

Neff, B.D.*. Western University. **An enduring legacy: 50 years of research into sunfish mating systems.** Miles Keenleyside had a foundational role in understanding the mating systems of sunfishes, with an emphasis on understanding questions related to cuckoldry, parental care, and barriers to interspecies hybridization. My own research program has continued to build on Keenleyside's research, incorporating new tools to address these questions. First, I used molecular markers to quantify the extent of cuckoldry in bluegill sunfish, showing that about a quarter of all eggs in a male's nest were fertilized by other males. This cuckoldry is predominantly achieved by specialized cuckolder males, which mature early in life and never adopt a parental life history tactic. I next examined how this lost paternity affects parental care decisions, and showed that the care a parental male provides to the eggs in his nest is negatively related to the abundance of cuckolders during spawning. Interestingly, parental males are able to re-assess their paternity when the eggs hatch, increasing care when paternity is high and decreasing care when paternity is low. Finally, Keenleyside demonstrated strong barriers to mating between parental males and females from different species of sunfish, but was not able to reconcile this observation with the high frequency of hybrid sunfish. Using molecular markers, my lab has shown that cuckolder males frequently subvert female mating preferences and are responsible for the high frequency of interspecies hybridization. (Oral)

Nelligan, C.*; Jeziorski, A.; Rühland, K.M.; Paterson, A.M.; Smol, J.P. Queen's University. **Lake Trout (*Salvelinus namaycush*) habitat trends in south-central Ontario lakes: Insights from ~40 years of end-of-summer hypolimnetic oxygen data.** Temperature-oxygen profiles, collected bi-weekly to monthly for ~ 40 years, were used to calculate end-of-summer volume-weighted hypolimnetic oxygen (VWHO) in six small, boreal lakes located in south-central Ontario. Temporal trends in optimal lake trout habitat were also assessed in two of the study lakes that support lake trout populations. Coherent decreases in thermocline depth and increases in hypolimnetic volume, mean hypolimnetic oxygen concentration and VWHO were observed in five of the six study lakes. However, all lakes underwent an abrupt increase in VWHO and mean hypolimnetic oxygen concentration after 2010. In the two lake trout lakes, variation in end-of-summer VWHO was best explained by total phosphorus concentrations and average winter temperatures preceding stratification. In contrast, variation in hypolimnetic volume was best explained by dissolved organic carbon concentrations. Across years, end-of-summer optimal lake trout habitat was most reduced (or absent) during the early-2000s, but increased after 2010, mirroring trends in VWHO. Although these data suggest a recent improvement in VWHO and lake trout habitat, continued regional warming may counteract these trends in the future. (Oral)

Noakes, D. L. G. Oregon State University, Corvallis, Oregon USA. **Recognizing Miles Keenleyside - 2019.** In this special Symposium we review and summarize the contributions that Miles has made to fisheries research in Canada during his career. Miles began as a protégé of Bill Hoar at the University of British Columbia. He was one of the first to study in the emerging field of ethology in Europe. His doctoral thesis on the schooling behaviour of fishes brought remarkable

clarity and rigorous experimental testing of hypotheses that were enduring characteristics throughout his career. He brought that experience, and scientific approach to the study of behaviour, ecology and fisheries management in Canada. With Fisheries and Oceans in New Brunswick he pioneered underwater observations of fish behaviour, including the disruptive effects of pesticides on behaviour and conservation. His faculty career at the University of Western Ontario focused on Centrarchids and Cichlids - but with detailed studies on species as diverse as sticklebacks, mudminnows, darters and coral reef fishes. His landmark volumes on diversity of behaviour in fishes, and the behaviour of cichlid fishes remain as current as ever as the standards for scientific quality. It is a personal pleasure and privilege to bring this Special Symposium to Miles at his home institution in his home city. (Oral)

Patoine, A.*; Karmakar, M.; Kurek, J. Université de Moncton, Campus de Shippagan (UMCS). **Differential impacts of climatic variability and land-use on the 20th century algal pigment abundance among and within two temperate estuaries of Atlantic Canada.** We ask what influence does landscape position play in determining the relative influence of climatic and land-use factors on the long-term variability of phytoplankton abundance along a brackish to marine gradient in two coastal catchments with relatively low human occupancy. Phytoplankton abundance in four taxonomic groups was estimated by HPLC quantification of algal pigments remains in four sediment cores extracted from two adjacent northeastern New Brunswick coastal catchments. Similarity was greater between pigment profiles extracted from different estuaries at similar distances upstream from the ocean than within a single estuary. Furthermore, increasing air temperatures were associated with increasing concentrations of alloxanthin (a biomarker of cryptophytes) at the mid-stream sites of both estuaries. In contrast, land-use factors were more important than climatic factors in explaining long-term phytoplankton abundance at the downstream site, with peak agricultural activities in the 1920s coinciding with peak algal abundances. Though preliminary, results indicate that climatic exposure and land perturbation intensity interact in determining the relative influence of environmental signals in these estuaries. (Oral)

Pearce, N.J.T.*; Thomas, K.E.; Lavoie, I.; Chambers, P.A.; and Yates, A.G. Western University. **Additive effects of sewage effluent on instream biological communities of agricultural rivers.** Sewage disposal is one of the most common forms of pollution to rivers and downstream waterbodies. Although advanced sewage treatment methods can improve effluent quality, sewage is often discharged into rivers exposed to pollution from additional upstream sources (e.g., agriculture). Cumulative effects from upstream may confound the response of biological communities to the addition of sewage effluent or improvements from management interventions. The objective of our study was to compare the effects of sewage effluent from two different treatment methods on biological communities (e.g., benthic macroinvertebrates and algae) of agricultural rivers. An upstream-downstream study design was implemented in 14 mid-order rivers in southern Ontario, Canada. Selected rivers either had a sewage lagoon outfall (n = 4), mechanical treatment outfall (n = 5), or no sewage outfall (n = 5) between sampling sites. Multivariate analyses and biotic indices will be used to evaluate changes in benthic macroinvertebrate and algae communities associated with sewage effluent additions. Results will identify the additive effects of sewage in agricultural systems and determine if the response

of benthic macroinvertebrate and algae communities are concordant, thus providing insights for improved biological monitoring of cumulative effects in stream environments. (Poster)

Perron, M.C.* , Pick, F.R. University of Ottawa. **Water quality effects on Odonata nymphs in urban ponds.** Stormwater ponds are constructed to receive urban runoff in order to mitigate flooding and downstream water pollution. Stormwater ponds can have poor water quality however wildlife is often attracted to these constructed wetlands. The objective of this study was to compare species assemblages of Odonata (damselflies and dragonflies) nymphs in stormwater ponds to those from natural ponds and to determine if water quality variables are driving Odonata diversity. A total of 28 chemical/physical variables were sampled in stormwater ponds (n=41) and natural ponds (n=11) along with Odonata nymph assemblages across the National Capital Region of Canada. Overall nymph abundance was significantly lower in the stormwater ponds compared to natural ponds. Damselfly species composition was significantly related to nitrogen concentrations whereas dragonfly species composition was significantly related to chloride concentrations and dissolved oxygen. Only a small percentage of the variation in the damselfly and dragonfly communities was explained by water quality; thus, other environmental factors are likely driving the nymphal diversity of Odonata in stormwater ponds. (Oral)

Persaud, A.A.* , Blais, J.M., Smol, J.P., Cheney, C., Sivarajah, B., Korosi, J.B. York University. **Paleo-ecotoxicology of Yellowknife (NWT) lakes impacted by historic gold mining activities.** Gold mining within Yellowknife (Northwest Territories) has historically contributed to economic development and prosperity to the region. Unfortunately, these mining activities resulted in the release of highly toxic arsenic into the atmosphere during 1938-2004. Giant Mine (1948-2004), for instance, contaminated lakes within a 15 km radius of its roasting operations. In the case of Pocket Lake (~1km from Giant Mine's roaster stack), analysis of a sediment core revealed the functional extirpation of Cladocera, a keystone group of microinvertebrates, following this contamination. While there have been some lab-based studies on the ecotoxicological effects of the arsenic contamination on individual Cladocera taxa, most notably *Daphnia*, these were all conducted on short timescales. My research will examine the less understood long-term ecotoxicological impacts on Cladocera through a paleo-ecotoxicological approach. We are examining regional changes in Cladocera using traditional paleolimnological techniques, to assess how assemblages have changed since mining operations began along a gradient of distance from Giant Mine. We will complement this traditional paleolimnological approach with ecotoxicological bioassays conducted on present-day and historic (resurrected from resting eggs) populations of Cladocera, to better understand the potential mechanisms driving the responses of Cladocera to arsenic pollution in Yellowknife lakes, part of an emerging "paleo-ecotoxicological" framework. (Poster)

Pleizier, N.K.* , Algera, D., Cooke, S.J., Brauner, C.J. University of British Columbia. **The effects of total dissolved gas on fish physiology and survival.** When water spills from a dam air is entrained below the surface and dissolves under pressure; as a result, total dissolved gases (TDG) of water increase and downstream waters become supersaturated. Exposure to elevated TDG induces bubble growth in the tissues of fish which can lead to injury and death, known as

gas bubble trauma (GBT). Despite over a hundred experimental studies on the topic there is no current model for the relationship between TDG and mortality. As a result, guidelines for TDG downstream of dams do not account for important factors that affect the severity and progression of GBT in fish. We conducted a systematic-type review of time to mortality and the time to GBT of fish in TDG supersaturated treatments in laboratory studies. We also conducted an experiment to determine the time to loss of equilibrium of fish exposed to TDG to test the theoretical model for the relationship between depth and GBT. We propose a model of fish mortality in TDG supersaturated water which includes important environmental factors. We also present our experimental findings that depth reduces the effect of TDG on GBT in fish as predicted by the model of bubble growth in water. (Oral)

Portt, C.B*, Coker, G., Reid, J., Vanengen, R., Ellenor, J. C. Portt and Associates. **Habitat characteristics and fish community in small, seasonal arctic streams in the Kivalliq Region, Nunavut.** Small streams in the Kivalliq Region of Nunavut were examined during three summer field seasons as part of baseline data collection for a proposed mine. Width, depth, substrate and habitat type (pool/flat/riffle) were quantified using a point-transect method. Temperature loggers were deployed from late June or early July through late August. Fish were sampled using backpack electrofishing, gee-type traps, fyke nets and gill nets. Some of the streams consisted of a single channel; others were anastomosed with up to eight separate threads. Mean total wetted width ranged from 0.7 m to 7.2 m. The streams were shallow (overall mean depth = 0.09 m), dominated by peat and cobble substrate, and composed primarily of riffles and flats. Maximum water temperature ranged from 19.5°C to 28.3°C, varying among streams and among years. Fyke nets and gill nets captured very few large fish moving upstream during or immediately after spring freshet. During or immediately after spring freshet low numbers of juvenile Arctic Char (*Salvelinus alpinus*) and adult Ninespine Stickleback (*Pungitius pungitius*) and Slimy Sculpin (*Cottus cognatus*) moving upstream were captured in Gee-type traps and small-mesh fyke nets. Electrofishing catch-per-unit-effort was low throughout the open-water season. (Oral)

Potts, L.B.*; Chapman, L.J.; Mandrak, N.E. McGill University. **Effects of thermal stress and hypoxia on the endangered Pugnose Shiner.** Hypoxia (low dissolved oxygen) and climate warming have both been identified as significant threats to freshwater fishes, which may limit fitness and performance traits. Furthermore, climate change is likely to exacerbate impacts of hypoxia on fishes because oxygen solubility decreases with rising temperature while fish metabolism increases. The objective of this research is to examine the independent and interactive effects of hypoxia and elevated water temperatures on Pugnose Shiner, *Notropis anogenus*, an endangered fish under the Canadian Species at Risk Act (SARA). We reared juvenile Pugnose Shiner live-captured from SUNY Cobleskill, NY to six ecologically relevant temperatures. We quantified thermal tolerance by examining critical thermal maximum (CTmax) and agitation behaviour under both normoxic and hypoxic conditions (acute exposure). We calculated metabolic rate (SMR/RMR) and estimated hypoxia tolerance by identifying critical oxygen tension (Pcrit). This research is in progress; however, preliminary results suggest that fish reared under elevated water temperatures exhibit thermal compensation under normoxic but not hypoxic conditions. This research was coupled with a field survey in

Thompson's Bay, St. Lawrence River that examined the distribution of Pugnose Shiner relative to environmental variables, including temperature and dissolved oxygen. (Oral)

Prairie, Y.T. Université du Québec à Montréal. **The interactions between eutrophication and climate change on the role of inland aquatic systems in the global carbon cycle.** Lakes and rivers of the world are subjected to multiple and simultaneous environmental changes. How these changes have already affected the greenhouse gas footprint of lakes is largely unknown and even less can be predicted for the future. In this paper, we will use intermediate climate change scenarios from the IPCC as well as projected human population growth to assess their likely combined effects of GHG emissions. For the North American continent, our simulations suggest that inland waters will respond to these environmental pressures with substantial increases in GHG emissions, in particular for methane (about 60%). The role of lakes on the global C cycle is therefore changing and constitute a significant additional source of GHG to the atmosphere. (Oral)

Prevost, A.D*, Hill, N.L, Grant, J.W.A, Ardren, W.A, Fraser, D.J. Concordia University. **Patterns of reproductive success among reintroduced Atlantic salmon in two Lake Champlain tributaries.** Reintroduction programs are increasingly implemented to regenerate self-sustaining salmon populations. The extent to which returning adults successfully produce surviving offspring is useful for informing reintroduction efforts but often unknown, as is knowledge of the genetic makeup of those offspring. We investigated the patterns of reproductive success among returning Atlantic salmon reintroduced as juveniles in two tributaries of Lake Champlain, by combining redd surveys (n=120) and DNA parentage analysis. Tissue samples collected from returning adults and their offspring produced in the wild were genotyped using microsatellite loci. Our results suggest that a low proportion of returning adults produced surviving offspring in either tributary (range 2-9%, or 11-15 of 124 and 3-4 of 81 returning adults, respectively) and that reproductive success was not variable among the sexes. These results demonstrate that adults can naturally and successfully reproduce in both of the studied tributaries (Winooski River, Boquet River). Nevertheless, a larger number of breeders would need to produce offspring in subsequent years to demographically augment the reintroduced population whilst avoiding short-term issues associated with low genetic diversity and inbreeding. Our results also point to underlying ecological problems which may have reduced reproductive success and potential genetic issues within the hatchery-reared population being used for supplementation, indicating further adaptive management will be useful to ensure self-sustaining populations in this system. (Oral)

Purchase*, C.F., Rennie, M.D., Rooke, A.C., Treberg, J.R. Memorial University. **Old funks don't always have junk spunk: a clear lack of reproductive senescence in sperm quality within the long-lived indeterminate growing lake trout.** Senescence, declining performance with increasing age, is a tenet of animal fitness, with reproductive senescence especially important in iteroparous species. Although females have received more focus, male senescence should be more pronounced as sperm are continually produced. Senescence is maladaptive but selection on old individuals, who have already reproduced, is generally weak. Senescence has been most studied in determinant vertebrates (mammals, birds), but consequences are predicted to be

greater for long-lived indeterminate growers (fishes, reptiles), whose fecundity increases with age/size. Selection should therefore more easily eliminate senescence in long-lived indeterminate growers. Testing this is difficult, especially in the wild, as age comparisons are confounded by size, and subsequently diet, which is known to affect gamete quality. To overcome this we exploit a unique multi-decade repeated sampling regime of spawning lake trout at the IISD-Experimental Lakes Area in Northwestern Ontario. Two unexploited populations were chosen that have simplified food webs, such that trout increase very little in size once mature, and sperm comparisons across age are not muddled by diet. As predicted by theory, sperm quality did not vary across lake trout aged 4-37. (Oral)

Quinlan, R.*; Perlov, D.A.; Reavie, E.D. York University. **Are the Great Lakes TOO great for using chironomids to reconstruct past changes in deepwater hypolimnetic oxygen? A cautionary tale from Lake Erie.** When long-term monitoring data is lacking, or anthropogenic stressors have been affecting an aquatic ecosystem prior to monitoring, paleolimnological approaches are useful for reconstructing long-term environmental histories of lakes and ponds such that pre-disturbance conditions can be inferred. Often a single sediment core taken from a deep mid-basin coring site is sufficient to capture paleoenvironmental information that has been integrated from the entire lake basin. In a previous study we used subfossil midge (Diptera: Chironomidae) assemblages to reconstruct past changes in Lake Erie hypolimnetic oxygen over the last 150 years. Results showed a substantive change in assemblages at approximately 1950 AD, inferring a further decline in hypolimnetic oxygen from circa 1850 AD conditions where Lake Erie already experienced hypoxic or anoxic conditions. We were struck by the species-poor assemblages, and a complete lack of littoral taxa, throughout the core stratigraphy, as littoral taxa normally re-deposit into mid-basin sediments. A comparison to data from benthos sampling through the 1970s-1990s suggests that our mid-basin Lake Erie coring site was too far from the littoral area to capture any paleoinformation about changes in nearshore environments. We discuss possible remedies to improve the usage of subfossil midges in paleolimnology studies in the Great Lakes. (Oral)

Raby, G.D.*; Johnson, T.B., Fisk, A.T. Great Lakes Institute for Environmental Research, University of Windsor. **Pop-off data storage tags reveal niche partitioning among predators in Lake Ontario.** Conservation practitioners interested in restoring an extirpated native species may find that its historical niche no longer exists or is occupied by non-native species. In Lake Ontario, fishery managers are in the midst of long-term efforts to restore native lake trout and Atlantic salmon while they continue to stock non-native Pacific salmonids into the lake, most notably Chinook salmon. All salmonids in Lake Ontario are top predators once they reach adulthood and could therefore be in competition; a process that should result in niche partitioning. We used pop-off data storage tags (pDSTs) that were externally attached to Chinook salmon (non-native, introduced) and lake trout (native, undergoing restoration efforts) and that recorded depth and temperature at 70 s intervals for a year before releasing from the fish for recovery and download. The data complement recently published stable isotope data for these species, and show that Chinook occupy warmer and shallower waters throughout most of the year, but exhibited less thermal niche diversity among individuals than did lake

trout. The data also allowed us to make comparisons of vertical activity, providing a glimpse into behavioural differences that likely relate to distinct foraging strategies. (Oral)

Remmer, C.R.*; Neary, L.K; Owca, T; Wolfe B.B; Hall, R.I. 1Department of Biology, University of Waterloo, Waterloo, Ontario, N2L 3G1, Canada. **Isoscapes and limnoscapes of the Peace-Athabasca Delta: A foundation for hydrolimnological monitoring.** High-latitude freshwater landscapes are particularly vulnerable to combined effects of climate change and industrial development. Inadequate knowledge of hydrological and limnological conditions over space and time hampers ability to detect trends and causes of aquatic ecosystem change. The Peace-Athabasca Delta (PAD), Alberta, is recognized as a Ramsar Wetland of International Importance and contributed to the listing of Wood Buffalo National Park as a UNESCO World Heritage Site. Small changes in water levels can alter hydrological connectivity in the delta, which influences habitat availability, biodiversity, ecosystem productivity and access by First Nations to traditional lands. Water isotope tracers and water chemistry were measured at 60 lakes in the PAD 3-4 times during the 2015-2018 ice-free seasons. Isotope-mass balance modelling of lake evaporation-to-inflow ratios and use of multivariate statistics to identify limnological associations were combined with geographic information systems (GIS) to generate “isoscapes” and “limnoscapes”. This approach highlights areas of the delta that are influenced by river flooding and evaporative water loss, and the resulting gradients of limnological conditions. Effective visualization of rapidly shifting hydrological and limnological conditions across the 6,000 km² PAD landscape provides a sensitive tool for monitoring the response of aquatic ecosystems to multiple potential stressors. (Oral)

Rennie, M.D.*, Milling, A., Colvin, T. and Paterson, M.J. Lakehead University. **Hold the shrimp: does extirpation of *Mysis* alter fish communities?** The *Mysis* shrimp (*Mysis diluviana*) has been described as a keystone species; as a meso-trophic pelagic omnivore, it has been shown to play an important role in the diet and growth of lake trout and in magnifying contaminants of pelagic fishes. However, these conclusions have been drawn through surveys that compare aquatic ecosystems that vary in food web structure (e.g., those with and those without *Mysis*). At the IISD Experimental Lakes Area, Lake 223 was the site of a multi-decadal acidification experiment, where the pH of the lake was manipulated from the late 1970's until the 1990's and *Mysis* were extirpated in the early 1980's. Though the pH of the lake has recovered chemically and all other species that disappeared from the lake have returned, *Mysis* remain absent from the lake. To evaluate the importance of *Mysis* to the food web structure of the Lake 223 fish community, we compared attributes of fishes prior to acidification and following the chemical recovery of Lake 223. Preliminary analyses indicate a reduction in lake trout population size and growth rates and increased mercury concentrations. Benthic fish and invertebrate densities will also be evaluated. (Oral)

Richter, I*.; Jackson, Don; Jones, Nick. University of Toronto. **Can the metabolic theory improve productivity estimates of stream fish communities?** Human activities can affect the capability of aquatic systems to produce fish. Models are needed that can accurately predict the productivity of fish communities to assist resource managers and support policy. In this study, we evaluate past productivity models and determine whether the metabolic theory of ecology

can further improve predicting stream fish productivity. We used literature estimates of productivity along with novel estimates of production of stream fish populations and communities to compare model (predicted) and empirical (observed) estimates. Model estimates of productivity were calculated using biomass, body size, and mean annual air temperature. Standard productivity models accurately predicted productivity from biomass and body size. The metabolic theory model produced estimates that were strongly correlated with the empirical estimates although the standardization coefficient was inappropriate as the model was biased relative to empirical estimates. The temperature component did not significantly contribute to the model. These results suggest that the empirical models are accurate and that the metabolic theory model, with an appropriate normalization coefficient, can predict biomass production. This study provides support for the metabolic theory while also validating past productivity models for riverine fish communities. (Oral)

Ricker-Held, A*. Trent University. **The contribution of invertebrates to the seasonal diets of walleye in Lake St. Joseph.** Walleye (*Sander vitreus*) are a top predator in many Ontario lakes and are known to be effective hunters in low light levels for both fish and invertebrate prey. Although they are an economically significant fish species for Ontario's recreational and commercial fisheries, information on their seasonal foraging behaviour is generally lacking within the scientific literature. Further, because Walleye are effective piscivores, their behaviour as insectivores is not well known, yet anglers are well aware that walleye can target invertebrates such as Mayflies (Ephemeroptera) over the summertime. This research examines the diets of different life-stages of Walleye in Lake St. Joseph, a large lake in northern Ontario. Unlike previous studies which focus on adults, this work will focus on the seasonal and developmental aspects of insectivory in Walleye. The main method includes analysing walleye stomach contents by morphological identification of prey and DNA methods. Northern regions of Ontario are under increasing pressure for development, resource extraction, and climate change. As such, understanding the role of invertebrates and fish prey species in Walleye ecology is critical to identifying and preserving important walleye habitat and resources. (Poster)

Ridgway, M.S.* , Middel, T., and Bell, A. Harkness Laboratory of Fisheries Research, Aquatic Research and Monitoring Section, Ontario Ministry of Natural Resources and Forestry. **The essential role of fish behaviour in the detection process of monitoring programs.** Lifting a net with fish in it is the outcome of many steps leading to capture, each step with fish behavior as an essential element of detection. Understanding these steps allows for catch to be converted to a measure of abundance. This is important for species like brook trout where abundance estimates are used for conservation decisions as well as providing harvest recommendations in land claims. Here we focus on the detection process based on short duration gillnet sets (1 hour set times) used in monitoring brook trout populations in lakes. We begin with the Royle-Nichols occupancy model, and through a combination of a long-term tagging study and acoustic arrays tracking free-ranging fish, we show that several detection steps can now be estimated including general availability to a sampling gear - perhaps the most difficult component of detection. One fascinating outcome is that availability of fish to sampling gear based on Bayes' theorem appears to be independent of set duration for different species. We end with a

recommendation for how this information can be communicated with managers and the public including a demonstration that catching less fish is more informative. (Oral)

Roloson S.D.*; Knysh K.M.; Coffin M.R.S.; Gormley K.L.; Pater C.C.; van den Heuvel M.R. University of Prince Edward Island. **Rainbow trout (*Oncorhynchus mykiss*) habitat overlap with wild Atlantic salmon (*Salmo salar*) and brook charr (*Salvelinus fontinalis*) in natural streams: Do habitat and landscape factors override competitive interactions?** Non-native rainbow trout (*Oncorhynchus mykiss*) have established across Prince Edward Island (PEI), Canada. Since the only plausible competitors in these systems are Atlantic salmon (*Salmo salar*) and brook trout (*Salvelinus fontinalis*), PEI represents an ideal setting to study the effects of rainbow trout. The purpose of this study was to update rainbow trout invasion status, delineate factors that increase the invasion probability, and quantify habitat overlap between rainbow trout and Atlantic salmon and brook trout. Analysis of landscape-level variables in 26 watersheds (14 with and 12 without rainbow trout) demonstrated that watershed slope, percent agricultural land use, and distance to nearest rainbow trout population significantly increased the probability of rainbow trout establishment. Two independent reach-level fish community surveys were conducted by electrofishing in combination with habitat surveys. Reaches with rainbow trout had higher stream slope, Atlantic salmon were found in wider reaches with larger substrate, and brook trout were dominant in headwater reaches with finer substrate. Findings at multiple ecological scales illustrated that rainbow trout invasion success is positively influenced by the presence of high-slope habitat. Habitat separation of the three salmonid species indicates that competition with rainbow trout may not be the most significant threat to native salmonid populations. (Oral)

Roloson S.D.*; Knysh K.M.; Coffin M.R.S.; Landsman S. J.; van den Heuvel M.R. University of Prince Edward Island. **The establishment of anadromy in non-native rainbow trout: Insights from acoustic telemetry and otolith microchemistry.** On Prince Edward Island, non-native rainbow trout (*Oncorhynchus mykiss*) have recently established anadromous populations which is thought to promote dispersal of the species. Acoustic telemetry and otolith microchemistry were used to study migratory patterns in three established populations. Telemetry metrics showed between-system differences in movement patterns, specifically a varying degree of reliance on tidal refugia at the head of tide. Monitoring of oxygen and temperature showed that midsummer temperature elevations and oxygen perturbations had the potential to deter, or even preclude, movement into estuary habitats. Between-site differences in salinity mixing were reflected in otolith microchemistry. Fish on the Dunk River showed elevated barium concentrations (Ba:Ca), reflecting occupancy of tidal refuge. Meanwhile, Montague River exhibited elevations in strontium (Sr:Ca) associated with marine occupancy. While otolith microchemistry provided general life history information, it only broadly described anadromous movements. Telemetry was superior to otolith microchemistry as it provided higher temporal and spatial resolution. In conjunction with real-time water monitoring, telemetry can provide insights into behavioural responses to dynamic perturbations in water quality that commonly occur in PEI estuaries. This study adds to the increasing awareness of potential for these two techniques to validate and complement each other. (Poster)

Rooke, A.C.*; Fox, M.G. Trent University. **The winter munchies: Feeding throughout winter is common in juvenile Pumpkinseed and improves energy reserves available in spring.** Feeding during winter is often assumed to be negligible in warmwater fishes; however, if fishes are able to effectively digest prey under these conditions, then feeding would supplement energy reserves and help mitigate the risk of winter starvation. Here, we determine whether juvenile Pumpkinseed (*Lepomis gibbosus*) are willing to feed at cold temperatures, and whether feeding can supplement energy reserves. We compared Pumpkinseed from two cold-climate, and two warm-climate populations to determine whether winter feeding is more prevalent in populations that experience a higher risk of winter starvation. Under simulated winter conditions, Pumpkinseed with access to prey readily fed throughout the winter and had larger lipid mass in spring than those that were starved. Despite similar consumption, feeding improved lipid mass to a greater extent in the cold-climate populations than the warm-climate populations. Pumpkinseed overwintering in outdoor ponds also fed regularly throughout winter. The pattern of lipid loss over time varied dramatically among populations, suggesting that pond-specific environmental conditions were important to shaping how energy reserves were used. Winter feeding may be more common in juvenile warmwater fishes than previously thought, and should be taken into account when considering the factors influencing first-year recruitment. (Oral)

Rosenfeld, J. S. *. British Columbia Ministry of Environment. **Technical, strategic, and policy considerations around setting Recovery Targets (Population and Distribution Objectives) for species at risk.** Recovery Targets for threatened and endangered species (also known as Population and Distribution Objectives) are key parameters that influence most aspects of species recovery, including the likelihood of species persistence, the overall footprint of species occurrence across a landscape, the extent of critical habitat, and socio-economic impacts of recovery. Developing a transparent, coherent, and scientifically defensible framework to guide establishment of recovery targets remains a significant science and policy challenge over a decade after the Canadian Species at Risk Act was brought into force. Because recovery targets have the potential to exert significant leverage on economic outcomes, it is particularly important to clearly define the respective roles of objective science and socio-economic considerations in the target-setting process. I review how recovery targets are influenced by the historic distribution and abundance of a taxon, current threats, and the technical feasibility of recovery; and when objective science and socio-economic values can influence recovery targets within current policy and legislative frameworks. (Oral)

Ruppert, J.L.W.* , Lawrie, D.L., Taylor, N. Toronto and Region Conservation Authority. **Cumulative thermal impacts of storm water pond outflows on instream aquatic ecosystems.** To mitigate potential impacts of impervious cover, Storm Water Management Ponds (SWMP) have been adopted as a tool. SWMPs are expected to reduce potential water quantity and quality stressors to aquatic life (TRCA & CVC, 2010; Liana & Sarah, 2018). While SWMPs undoubtedly reduce the impact of potential stressors, these reductions may not be below suitable thresholds for many species and SWMPs introduce new stressors (Tuccillo, 2006; Islam et al., 2011). Of note, peak summer temperatures (July-August) produce high water temperatures in SWMPs, where outflows from ponds can raise the temperature of nearby

fluvial systems (Sabouri et al., 2013; Hester & Bauman, 2013). Using study reaches in the City of Brampton and the City of Richmond Hill, we will assess (1) cumulative thermal impacts of SWMPs, (2) determine the role of groundwater discharge and its role to counteract impacts of SWMP outflows and (3) assess the response of the aquatic ecosystem through (a) target species (Endangered Redside Dace; *Clinostomus elongates*) and (b) aquatic communities (fish and benthic macroinvertebrate surveys). Given that future climate change may also further exacerbate instream temperatures, there is a pressing need to quantify the potential risks of SWMPs to develop strategic plans that conserve aquatic biodiversity. (Poster)

Ruzzante D.E.*, McCracken G.R., Førland B., MacMillan J., Notte D., Mills Flemming J., Skaug H. Dalhousie University. **Validation of the close kin mark recapture (CKMR) approach for the estimation of abundance in harvested, small, or data limited systems.** We estimated abundance (N_c) in seven brook trout (*Salvelinus fontinalis*) populations using genetic information and the close kin mark recapture (CKMR) approach. This approach is based on the principle that an individual's genotype can be considered a "recapture" of the genotypes of each of its parents. Assuming offspring and parents are sampled independently, the number of Parent-Offspring-Pairs genetically identified in a large collection of both groups can be used to estimate abundance. Using data collected over 4 consecutive years (2014-2017, ~2400 individuals, aged, 33 microsatellites), and accounting for various sources of uncertainty, we found close agreement between standard mark-recapture abundance estimates (double-pass electrofishing) and the CKMR estimates, which require information on age-specific fecundity, and population- and age-specific survival rates. Populations were estimated to range in size between 300 and 8000 individuals. Knowing how many individuals there are in a population is a fundamental problem in the management of exploited marine fish where abundance is traditionally estimated with catch-per-unit-effort (CPUE) data. CPUE statistics can, however, be subject to significant bias and uncertainty, and are thus often considered relatively unreliable and contentious. Our study validates CKMR as a useful approach for the estimation of abundance in certain harvested and data limited systems. (Oral)

Salisbury, S.J.*, McCracken, G.R., Perry, R., Keefe, D., Koop, B.F., Nugent, C.M., Ferguson, M.M., Danzmann, R.G., Ruzzante, D.E. Dalhousie University. **Genetic divergence among sympatric resident and anadromous Arctic char (*Salvelinus alpinus*) in Labrador.** It has been argued that the large plastic capabilities of Arctic char are responsible for the lack of evidence of genetic differences among sympatric resident and anadromous forms of this species. In contrast to this hypothesis and in accordance with similar observations in other salmonid species, we observed significant neutral genetic differences among sympatric resident and anadromous char forms in Ramah lake (Labrador) using microsatellite markers (Salisbury et al. 2018, CJFAS). Building upon this work, we employed an 86 K Arctic Char SNP chip to investigate the specific genomic differences among the Ramah resident and anadromous forms. We also sequenced samples from additional Labrador lakes to look for further evidence of genetically differentiated resident and anadromous char. We specifically targeted sea-accessible lakes which, like Ramah, contained small, mature, putative resident char and large, mature, putative anadromous char. The results from our SNP Chip analysis verify the genetic divergence among resident and anadromous char in all lakes examined. The anadromous forms in some of these lakes likely

contribute to the local commercial fishery. The observed genetic differences among these resident and anadromous char suggest the need for their independent management and offer insights into the genetic underpinnings of early speciation. (Oral)

Schiff, S.L.*; Muir, D.C.G.; Dainard, P.; Aukes P.J.K.; Elgood, R.J.; St. Louis, V.L.; St. Pierre, K.A.; and Lehnherr, I. University of Waterloo. **Are today's fish "14C old" and getting "older" in the northernmost Great Lake (Lake Hazen) in the High Arctic?** Fish are an important source of food but are also integrators of terrestrial processes and contaminant pathways. Lake Hazen is a large (538 km²; 265 maximum depth) inland lake in Quttinirpaaq National Park, Nunavut with terrestrial inputs dominated by glacial fed rivers. The Lake Hazen watershed has undergone rapid and unprecedented change within the past decade. Lake water residence time has decreased by a factor of four, concomitant with increases in river discharge and the lake is no longer at steady state with respect to chemical inputs. Lake Hazen is ultra-oligotrophic with rates of primary production that are exceedingly difficult to measure, yet hosts a population of non-anadromous Arctic char (*Salvelinus alpinus*) with fork lengths up to 70 cm and upper age limits approaching 35 years. Terrestrial dissolved organic and inorganic carbon (DOC and DIC) entering the lake has a 14C age that is relatively "old". In tandem, both the DOC and DIC within Lake Hazen are 14C "old". We present analysis of 14C of fish collected in several years between 1992 and 2017. Given the recent observed increases in glacial runoff, do Arctic char record these changes in the carbon cycle? Are the Arctic char becoming "older" ? (Poster)

Scott, R.W.*; Tank, S.E.; Wang, X.; Quinlan, R. York University. **Benthic assemblages as biological indicators of altered hydrological connectivity in a climate-sensitive delta floodplain - 5 years of monitoring lakes in the Mackenzie Delta, NT.** Relatively little is known about the potential impact of climate change to the biota of northern deltaic floodplains in which the flood cycle is driven by spring ice dynamics. In such systems the duration and extent of flooding depends on the timing of ice breakup, which in addition to increased permafrost subsidence and evapotranspiration makes them susceptible to multiple stressors. We investigated limnological and benthic assemblages in 10 lakes over 5 years (2013 - 2017) in the Mackenzie Delta (Northwest Territories). The lakes represented a gradient of connection times based on sill elevation ranging from a few days per year to the duration of the ice-free season, and among years peak flood level and timing of ice breakup varied by 1.6 m and 16 days, respectively. Ionic composition, DOC and DIC varied significantly with connection time. Multivariate ordinations showed connection time to explain the most variation in benthic macroinvertebrate composition. Although family-level taxonomic resolution was used in this analysis, benthic communities varied significantly, with higher proportions of aerial dispersers, predators, and Chironomidae in more isolated lakes, and certain families varied significantly in relative abundance along a hydrological connectivity gradient. Species-level identification will improve the detection of macroinvertebrate responses to changes in connectivity. (Oral)

Séguin, J.Y.*; Mason, J.; Hanson, M.; Hollebhone, B.P.; Orihel, D.M.; Palace, V.; Rodriguez-Gil, J.L.; Kimpe, L.; Blais, J.M. Canada. **Bioaccumulation and toxicokinetics of polycyclic aromatic compounds and metals in the freshwater mussel *Pygandon grandis* exposed to water from a simulated diluted bitumen spill in boreal lake enclosures.** Canadian bitumen is mainly

transported via pipeline, train, and trucks, all posing a risk of diluted bitumen (dilbit) spills into the environment. In the summer of 2018, a collaborative large-scale field experiment was conducted at the IISD-Experimental Lakes Area, to assess the impacts of a dilbit spill in a freshwater Boreal lake. The research objectives of the Boreal lake Oil Release Experiment by Additions to Limnocorrals (BOREAL) project are to understand the fate, behaviour, and potential toxic effects of dilbit to inform evidence-based management strategies for the transport of dilbit in Canada. Here we identify the bioaccumulating compounds associated with naturally weathered dilbit in giant floater mussels (*Pygandon grandis*), and determine the rates at which they are accumulated and excreted. More specifically, the bioaccumulation and toxicokinetic parameters of polycyclic aromatic compounds and various metals were assessed in mussels exposed ex-situ for 41 days (25 days of exposure and 16 days of depuration) to water from the mesocosms treated with dilbit. There are significant knowledge gaps associated with these compounds when derived from naturally weathered dilbit, and results from this study will help us predict the bioaccumulation of these contaminants in freshwater mussels. (Poster)

Semeniuk, C.A.D*; Madliger, C.L.; Melles, S.J.; Morbey, Y.E.; Febria, C.M. University of Windsor - GLIER. **Inclusion and diversity in Canadian fisheries and aquatic sciences: time to reflect.** The Canadian fisheries and aquatic science (CFAS) community is mostly represented by two societies: the Canadian Conference for Fisheries Research and the Canadian Aquatic Resources Section of the American Fisheries Society. Each has experienced growth since inception, and offers key platforms for identifying and discussing Canadian issues and the future of fisheries and aquatic sciences professions. While the Canadian perspective is increasingly global with renewed federal interest focussing on climate change and the conservation and protection of fish(eries), we explore whether the CFAS societies and wider community have taken a similar inclusive approach. We qualitatively and quantitatively examined the CFAS societal structure and publications (e.g., Board membership, award winners, publication metrics) to describe trends over time and across dimensions of gender and representation. We interrogated whether the societies' equity, diversity and inclusivity (EDI) initiatives reflect the changing societal landscape, perspectives, experiences and priorities of scientists, practitioners and other professionals studying and applying fish and aquatic science across Canada. The analyses offer evidence at a critical time in the societies' discussions on EDI. We draw on additional learnings from global movements to further explore what can be done to improve the CFAS community. (Oral)

Shah, P.*; Venkiteswaran, J., Molot, L. Wilfrid Laurier University. **Phytoplankton fractionation of iron.** An increasing occurrence across Canada are cyanobacterial harmful algal blooms (cHABs) that can threaten economies and human health. HABs occur annually in nutrient-enriched and increasingly also in low-nutrient lakes, bays, and reservoirs used for drinking water supply and recreation. Factors such as high phosphorus and nitrogen concentrations and low mixing and flushing rates have been hypothesized to contribute to the risk of cHABs. However, these factors do not fully account for many cHABs, which remain a critical problem that current management models do not address. We hope to show the important role of Fe(II) in determining cyanobacterial dominance. Cyanobacteria need more Fe than their

eukaryotic competitors and are only capable of using Fe(II), reinforcing the hypothesis in cHABs formation. We will characterize the uptake and isotopic fractionation of Fe by different taxa of phytoplankton. By achieving this, we hope to gain a better picture of the role of Fe on cHAB formation and persistence. We will study the $\delta^{56}\text{Fe}$ in laboratory cultures to help explain observed changes in $\delta^{56}\text{Fe}$ signatures in particulate and dissolved phases in different strata of an intensively studied eutrophic lake during the ice-free season. This will lead to a better understanding of the role of Fe in bloom formation, and how bloom management should be approached. While P and N are key nutrients to control, the complex role of Fe needs to be elucidated to help improve management practices. (Oral)

Sherbo, B.*; Higgins, S.N.; Hann, B.J. University of Manitoba and IISD Experimental Lakes Area. **Effects of photodegraded dissolved organic matter on phytoplankton.** Terrestrially-derived organic matter (t-OM), considered a state variable in lake ecosystems, is increasing in lakes across eastern North America and Eurasia. Increasing t-OM can cause brownification of lakes as it is composed of coloured, aromatic, and high molecular weight compounds which are highly photodegradable. We evaluated the relationship between t-OM and phytoplankton across a lake-DOC gradient (3-12 mg L⁻¹) and within an in-situ t-OM photodegradation experiment. In the experiment, four treatments of amended lake water (control, DOC, nitrogen (N)+phosphorus (P), and DOC+N+P) were incubated in 4L buckets for two weeks and response variables were tracked. We hypothesized in low productivity boreal lakes that (1) photodegradation of t-OM would result in increased nutrient bioavailability, (2) increased phytoplankton productivity, and (3) increased algal biomass would occur. Across the natural lake gradient, t-OM was associated with increases in nutrients and phytoplankton biomass. In the experiment, phytoplankton biomass declined faster in the control and N+P treatments (0.005 RFU/day) than the DOC and DOC+N+P treatments (0.047 RFU/day). Phytoplankton growth (measured as electron transport rates) was most optimal in the DOC+N+P treatment, followed by N+P, DOC, and lastly the control treatment. Throughout the experiment, fDOM decreased by 80% which can be associated with photodegradation of larger coloured DOC compounds. (Oral)

Shuvo, A.*; Sharma, S; Gray, D. York University. **Drivers of fish occurrence in Arctic lakes.** Retreating glacial history, lakes separated by land barriers, and cold temperatures govern fish communities in the Canadian Arctic. Our objective was to understand the influence of lake characteristics and environmental conditions on fish communities in Inuvik, NWT lakes. We hypothesized that lake mean depth strongly influences fish community structure. Twenty-eight lakes, including 20 natural and 8 gravel pit lakes, were sampled for fish occurrence using mesh nets along the Dempster Highway near Inuvik, NWT. Bathymetric maps were used to measure lake morphometry and water quality was sampled using a multiparameter probe. Mann-Whitney U tests suggest that environmental conditions were similar amongst sampled lakes with and without fish (Mann-Whitney U, p-value>0.05) owing to lake oligotrophy. Redundancy analysis revealed that surface area was the only influential environmental variable structuring fish community composition (RDA axis 1 variance = 11.3%, p-value<0.05) which is supported by the species-area relationship - larger lakes have greater fish species diversity. Since lake morphometry and environmental conditions do not differ between lakes with or without fish,

we propose to examine lake connectivity, fish migratory rates, and trophic interactions to better understand drivers of fish community composition in Arctic lakes. (Oral)

Simmons, D.* , Sherry, J., Neheli, T., Miller, J., Poirier, D., Watson-Leung, T., Chong Kit, R., Reiner, E., Simpson, M. University of Ontario Institute of Technology. **The effects of waterborne chromate (Cr6+) on protein abundance patterns in Lake trout (*Salvelinus namaycush*)**. In anticipation of the development of the Ring of Fire in Northern Ontario for the mining of Chromium, we assessed the effects of CrVI on the plasma proteome of Lake Trout, a species which is native to that region. Juvenile Lake trout were exposed in the laboratory to waterborne CrVI (0, 0.2 ppb and 3 ppm) for 21-days in flow-through conditions. The 3 ppm treatment was halted after 7-days due to mortalities. Plasma proteins were analyzed using a reverse phase liquid-chromatography tandem quadrupole time-of-flight mass spectrometry system with data-dependent full scan acquisition, and peptide spectral files were subsequently sequenced and matched to proteins using bioinformatics software. Results from liver transcriptome analyses from these same fish indicate there was significant differential gene expression in both the 0.2 ppb and 3 ppm treatments that were related to cancer. There were also significant changes in concentration of some plasma metabolites. Plasma protein abundance will be compared to these results to detect where there is agreement between the two datasets and we will discuss how changes in gene expression caused by exposure to CrVI could result in higher level biological effects, and be used for monitoring fish health in Ring of Fire mining activities. (Oral)

Simmons, Sean. Canada. **Using citizen science to solve fisheries data gaps in Canada and provide managers with a new monitoring tool**. Canada has over a million fish bearing lakes and streams, however only a small number of them are monitored each year due to the high cost of traditional survey methods. As a result, the vast majority of fish bearing waters remain unmonitored and potentially at conservation risk. To address this issue we tested a new mobile app and website called MyCatch that encourages anglers to report their catch data. In the first six months of the project, catch rate data was collected on over 8,500 fishing trips, covering more than 2,400 waterbodies. This translates into a cost per waterbody of roughly \$200, a savings of at least two orders of magnitude from the cost of a traditional creel survey. This means fisheries researchers have a new tool to monitor a much larger scale of waterbodies with a much smaller budget. It also provides near real-time tracking so waterbodies that are undergoing significant changes can be more quickly spotted. Moving forward, further validation of the data is needed to evaluate the consistency with other methods of data collection, to assess sampling bias and to calibrate the model for use on lakes and streams where only self reported angler catch data is available. (Oral)

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. Queen's University. **Examining the long-term algal responses to metal contamination within the context of multiple environmental stressors: case studies of lakes around Yellowknife, NT**. The City of Yellowknife, Northwest Territories, is situated on the northern shores of Great Slave Lake and surrounded by many small subarctic lakes that have socio-economic importance. However, the lakes within the city limits have high concentrations

of arsenic, a legacy of 20th century gold mining operations in the area. In addition to the elevated pollutant concentrations (arsenic, antimony, and sulphate), the lakes around Yellowknife are also impacted by local land-use changes and climate warming. We used the paleolimnological approach to understand the long-term algal responses to multiple environmental stressors in lakes around Yellowknife. Specifically, we examined sedimentary diatom (microscopic siliceous algae) assemblages in radiometrically dated sediment cores from a suite of lakes around Yellowknife. Our data provides strong evidence that the primary producers from lakes around Yellowknife have been altered by mining operations, as well as local land-use changes and recent warming, over the past ~100 years. Furthermore, the biota of these lakes have not returned to pre-disturbance conditions, as the contaminant concentrations are still high at some sites. The timing and nature of the biological changes in these lakes affected by multiple environmental stressors highlight the interactive effects of industrial contaminants, local land-use changes, and climate warming on the algal assemblages of lakes in climatically-sensitive subarctic regions. (Oral)

Smith, M.R.*; McLaughlin, R.L. University of Guelph. **You shall not pass! The effectiveness of a passive size-based method for selective fish passage.** Habitat fragmentation is often a significant detriment to population stability. Anthropogenic barriers often fragment aquatic habitat by limiting fish movement within stream systems. In particular, fragmented habitat between foraging and spawning sites could decrease the productivity of fishes within the system. This raises the possibility that selective habitat fragmentation could be used to control undesirable species. We evaluate the applicability of this technique for the management of invasive Sea Lamprey (*Petromyzon marinus*) in the Laurentian Great Lakes. We estimated the effectiveness of size-based passive sorting relative to current manual trap-and-sort techniques in current fishways in Lake Ontario, Erie, and Superior. We found that across all three fishway sites there was a positive correlation, however, the relationship indicates the potential passage of non-Sea Lamprey fishes caught within the fishway is significantly lower than the current manual trap-and-sort technique and highly variable (between 10% and 75%). The variability in success is due, in part, to the success of passively separating Sea Lamprey from desirable fishes. The effectiveness of size-based passive sorting is a promising method for selective fragmentation, however the variability within the effectiveness of different fishways demonstrates the need for further research into the causes of that variability. (Oral)

Smith, R.*; Swanson, H.; Loewen, T.; Dumond, A.; Kristensen, K. University of Waterloo. **Fall migration patterns and habitat use of anadromous Arctic char (*Salvelinus alpinus*) near Kugluktuk, Nunavut.** Higher temperatures and unpredictable weather patterns are affecting stream hydrology in the Canadian Arctic. Changes in stream flows can create barriers for migratory fishes, such as anadromous Arctic char (*Salvelinus alpinus*), which many Inuit communities rely on as a key food source. The Coppermine River has historically supported an important subsistence char fishery for the community of Kugluktuk, Nunavut. In recent years, community members have observed a sharp decline in the fall harvest of sea-run char. The cause of this decline is difficult to discern, particularly because overwintering and spawning locations are unknown to both scientists and local fishers. To further our understanding of habitat use and migration routes, we implanted acoustic transmitters in forty-eight mature,

anadromous Arctic char that were captured in common harvesting areas near Kugluktuk. Thirty-three acoustic receivers were deployed along suspected char migration corridors. We present preliminary telemetry results from the 2018 fall migration toward freshwater overwintering habitats. Gaining an understanding of critical char habitats and potential climate-induced impacts to migratory patterns will help ensure the sustainability of traditional food sources and subsistence harvesting practices. (Oral)

Starke, C.W.* Jones, C.L.C, and Frost, P.C. Trent University, Canada. **Life history shifts in *Daphnia pulicaria*: Interactive effects of water temperature and stoichiometric food quality?** While surface water temperatures vary widely within and among lakes, most studies of poor food quality on lake zooplankton have been conducted across a relatively narrow temperature range. Given this, there is a need to further examine the interactive effects of water temperature and poor food quality on the life-history of zooplankton. This study examined growth, reproduction, and mortality of *Daphnia pulicaria* exposed to variable food P content (C:P ~100-900) across a wide range of temperatures (~15-30°C). We found *Daphnia* growth responses to increasing water temperature varied with food quality with stronger negative effects of elevated temperature observed at low food C:P ratios. In terms of reproduction, the optimal temperature for total offspring production appeared to increase with food C:P ratios. While short-term survival was limited at very high temperatures irrespective of food quality, elevated temperatures reduced survival of animals consuming the lowest food C:P ratios across longer time periods. Our results show that effects of elemental food quality on *Daphnia* vary considerably with temperature and that these effects differ among life-history traits. At temperatures above 25°C, responses were complicated but indicate that future increases in lake summer water temperatures may have especially dire consequences for even well-nourished *Daphnia*. (Poster)

Stell, S.C.*; Van Leeuwen, T.E.; Brownscombe, J.W.; Cooke, S.J.; Eliason, E.J. University of Alberta. **An appetite for invasion: the energetics of feeding & digestion in invasive lionfish.** Species invasions threaten global biodiversity, and physiological characteristics may determine the success and impact of invasive species. Specific Dynamic Action (SDA), the increase in metabolic rate with feeding and digestion, strongly influences animals' energy budget and can vary with temperature, however the ecological significance of this temperature response is poorly understood. We investigated the relationship between SDA, aerobic scope, temperature, and metabolic phenotype in lionfish, an invasive species of major concern to western Atlantic marine ecosystems. We collected lionfish from reefs in The Bahamas and calculated their SDA and aerobic scope with intermittent-flow respirometry at two ecologically relevant temperatures (26° and 32° C). Maximum metabolic rate occurred during digestion and lionfish fed independently of their scope for activity, allowing them to assimilate more energy for reproduction and dispersal than species that must maintain a scope for activity to escape predators, forage, and migrate during digestion. The total energy spent on digestion was 25% lower at 32° than 26° C. While scope for activity decreased 23% from 26° to 32° C, absolute aerobic scope may have increased, suggesting lionfish are robust physiological performers at temperatures approaching their thermal maxima and can consume more prey as temperatures increase with climate change. (Oral)

Stitt, B.C.*; Goudie, M.T.; Humphries, S. Parks Canada Agency. **Conservation and recovery efforts for Westslope Cutthroat Trout using Rotenone.** Parks Canada Agency recently completed the initial phase to restore Westslope Cutthroat Trout (WSCT) at Hidden Lake and upper Corral Creek in Banff National Park using a rotenone based fish toxicant. Non-native brook trout were removed over a one day treatment period. The use of a fish toxicant was considered following the unsuccessful physical removal of brook trout from the project area over six years. The treatment area was defined by a waterfall barrier to upstream fish passage. Fish toxicant was applied to the treatment area using three methods over a 24 hour period. The fish toxicant was neutralized at the waterfall barrier to prevent non-target impacts downstream of the treatment area. WSCT were salvaged from immediately below the waterfall barrier to reduce non-target impacts prior to the application. Neutralization was initiated when fish toxicant application began. The neutralization process took 16 days. Rotenone concentration and stream and lake invertebrate monitoring were conducted prior to application, during application and/or post-application. Efficacy of the method will be elucidated using presence/absence sampling in future years. (Oral)

Stortini, C.H.*. Queen's University. **Island biogeography of macroinvertebrates in large marine ecosystems.** The Equilibrium Theory of Island Biogeography (ETIB) predicts that species richness is positively correlated with area and negatively correlated with isolation. ETIB has been widely tested in terrestrial and freshwater systems. Application of this theory to large marine ecosystems has been limited to a few studies, which confirmed that species richness increases with area in marine communities, and that reductions in predator abundance leads to increases in the slope of prey community species-area relationships. Much remains to be explored, including potential taxonomic group-specific differences in these relationships. I contrasted geographic patterns of diversity and community structure between marine macroinvertebrates and fish across the ten offshore, submarine banks of the Scotian Shelf, utilizing fishery-independent survey data from 2006-2017. I found that, while both groups exhibited strong species-area relationships, marine invertebrate community structure and diversity had greater dependence on the physical connectivity and surface temperature of the banks, while benthic fish communities were more influenced by bottom temperature. These results suggest that the biogeography of marine macroinvertebrates is strongly influenced by the processes governing larval transport, whereas communities of more mobile fish appear to be less structured by advective processes. (Oral)

Sutherby, J.S.*; Birceanu, O.; Wilkie, M.P.; and Jeffries, K.M. Canada. **The cellular stress response to an acute heat shock in larval sea lamprey with potential ecological consequences in a warming world.** How species respond to short-term thermal challenges can be used as a proxy to evaluate their reaction to future climate change-related temperature increases. We used RT-qPCR to evaluate the expression of several genes involved in the cellular stress response of sea lamprey (*Petromyzon marinus*), an invasive species in the Great Lakes which currently experiences temperatures up to ~30°C in some larval-hosting streams. Larval sea lamprey acclimated to 5, 13, and 20°C were exposed to thermal stresses of 26°C and 2°C below the acclimation-specific CTmax (~30.5, 31.5, 32.5°C, respectively), for one and four hours. Sea

lamprey rapidly upregulate an inducible transcription factor (*jund*) 10 to 40-fold and important molecular chaperones (*hsp90b1*, *serpinh1*) 10 to 100-fold. A recovery pattern was also observed in transcription factor expression following the 4h 26°C exposure, where expression returned to control levels. Our results indicate that acclimation-independent physiological thresholds may exist in larval sea lamprey, where the cellular stress response transitions first from typical homeostatic-maintenance to a protein-denaturation response at ~26°C, followed by another transition between 26°C and ~30°C to a more extreme cellular survival response. Due to climate change, the frequency of temperatures ~30°C will increase, potentially leading to a shift in sea lamprey larval distribution. (Oral)

Sutton, I.*; Jones, N.E. River and Stream Ecology Lab Ontario Ministry of Natural Resources and Forestry. **Can measures of fish community size structure be used as indicators in stream monitoring programs?** Characterization of community size structure may provide a non-taxonomic approach that is useful in assessing aquatic ecosystem health across a variety of stream types at broad spatial scales. We examined the relationship between land use and community size structure in wadeable streams across south-central Ontario. Sampling was conducted at two levels of intensity: single-pass electrofishing which is typical of monitoring programs and three-pass electrofishing that is typical of research studies. We primarily characterized community size structure using the size spectrum slope (the scaling exponent of the body size-abundance relationship) but considered additional metrics including size diversity, mean body size and body size range. Despite visual differences in size distributions (body size-abundance relationships, i.e. the size spectrum) we found no relationships between size spectrum slopes and land use. Alternative metrics including size diversity and size range were found to vary with land use. Small individuals were dominant at highly urbanized sites while the abundance of larger fishes decreased. Samples collected using single-pass electrofishing were frequently insufficient in size to accurately characterize the size spectrum slope, suggesting that characterization of community size structure may require effort beyond that which is typically seen in monitoring programs. (Oral)

Swanson, H.K.,* Baker, L.F., DeJong, R.A., Lord, S.I., and Smith, R. University of Waterloo. **Considering ecosystem connectivity: insights from the ecology and life history of three northern fishes.** In the challenging and unproductive aquatic environments of Canada's north, species persistence and intraspecific diversity are often facilitated by connectivity of habitats. While use of rich marine feeding grounds by northern anadromous fishes is perhaps the best-known example of how connectivity can increase population productivity, many northern fishes rely on connected estuarine and freshwater habitats, connected lentic and lotic freshwater habitats, and nutrient inputs from terrestrial to aquatic environments. In this presentation, I will use case studies from three northern fishes to highlight the importance of understanding complexity in life history and habitat connectivity when attempting to understand and predict effects of environmental change. (Oral)

Terry, M.W.*; Poesch, M. University of Alberta. **Role of acoustics in freshwater fisheries management: Applications in the Alberta oil sands.** As management strategies continue to progress towards ecosystem level objectives the potential role for acoustics in aquatic

monitoring programs has become increasingly evident. Its high spatial/temporal resolution and ability to remain effective over a range of environmental conditions provides significant advantages over traditional methods. Recent advancements in analysis techniques and software has allowed for increased access to the wealth of information stored in acoustic data, significantly extending the range of potential applications. This study will demonstrate the role of active acoustics in developing criteria for evaluating and enhancing management strategies in the Alberta oil sands while discussing other potential applications. Acoustic data from six natural lakes in the region will contribute to establishing a baseline for fisheries productivity and help quantify the behavioral and physiological responses of organisms to their environment. Preliminary analysis highlights fish distribution is not stochastic and a comparison of von Bertalanffy growth functions showed a significant difference in growth of northern pike between lakes. Understanding the mechanisms behind the observed patterns will help guide adaptive management strategies and ensure the long-term sustainability of freshwater resources in the region. (Oral)

Therrien, C.A.*, Morbey, Y.E., Neff, B.D. University of Western Ontario. **Effects of stream habitat structure on foraging in Atlantic salmon (*Salmo salar*)**. Stream restoration programs frequently focus on increasing habitat complexity and the availability of shelters for small fishes. However, the consequences of shelter availability on the foraging behavior and growth of important native species such as Atlantic salmon (*Salmo salar*) are not well-understood. Atlantic salmon were extirpated from Lake Ontario and since their extirpation; restoration attempts have focused on evaluating the suitability the LaHave and Sebago strains. How these two strains respond to an increase in shelter availability in Lake Ontario's tributaries may be an important factor that can influence their juvenile performance during restoration attempts. To address these knowledge gaps, I measured the foraging activity of juvenile Atlantic salmon from the two populations while they were held in pens in a Lake Ontario tributary that differed in their shelter level. Fish from both populations in high shelter had a foraging rate and activity level approximately 300% higher than those in the low shelter but these differences in behavior had no noticeable effect on growth or diet. There was also evidence that shelter influenced the timing of foraging activity in Atlantic salmon. The two populations tested did not differ in their foraging behavior or growth based on the metrics tested. Overall, I found shelter can influence the timing and rate of foraging in Atlantic salmon and these effects are conserved between populations. I will discuss how our data might help direct recovery efforts for Atlantic salmon. (Poster)

Thienpont, J.R.*, Eickmeyer, D.C., Korosi, J.B., Chin, K., Kimpe, L.E., Blais, J.M. York University. **Assessing polycyclic aromatic hydrocarbons (PAHs) and metals in sediments and benthic invertebrates near the Canol Shale Play (Central Mackenzie Valley, Northwest Territories)**. The Sahtu region has a long history of hydrocarbon exploitation; conventional oil has been extracted from the Norman Wells area since the 1920s. The Sahtu is also the location of the Canol Shale Play, a potential source of tight oil. Up until recently, when activities were suspended due to falling oil prices, there was strong interest in the development of this reserve. In 2014 and 2015, immediately following the February 2014 development of two test wells by hydraulic fracturing, we collected stream sediment and invertebrate samples throughout the

region. Additionally, in 2017 we collected sediment cores from six lakes. We assessed metals and PAHs, contaminants associated with oil and gas activities, but which are also found naturally. We recorded elevated PAH concentrations in sediments, including downstream of a 2014 test well. Importantly, invertebrates sampled at the same sites generally had low burdens of PAHs, suggesting limited bioavailability and/or efficient metabolism. Sediment cores provide a history of changes over at least the last three centuries, including the influence of emissions from nearby Norman Wells since the 1920s. Understanding the long-term and spatial distribution of contaminants is essential for putting the history of development in an accurate context. (Poster)

Third, L.*; De Kerckhove, D.; Chu, C. University of Toronto. **Quantifying uncertainty, error and time-discounting to inform compensation ratios for freshwater fish productivity within a new Metabolic Theory of Ecology model.** A major challenge facing natural resource management today is the accurate measurement and prediction of anthropogenic impacts on the environment, and determining how much compensation is necessary to prevent continual degradation. Canadian aquatic ecosystem management has a long history of offsetting and the prescription of “compensation ratios” to counterbalance unavoidable environmental losses. There is currently no clear quantitative framework in place for determining how much restoration should be required, especially when attempting to account for factors of uncertainty, error, and time discounting. This current lack of quantitative assessment exposes the potential for incredible unintended losses to our fisheries resources, and unsubstantiated costs to proponents required to implement increased restoration activities. I will assess the influence of three factors: (1) uncertainty, (2) measurement error and (3) time lags restoration of fish productivity (kg/ha/yr) within a new model framework, and derive activity-specific compensation ratios from previous federal habitat disturbance data. I will integrate this research with feedback from industry and government professionals to recommend scientifically-defensible and feasible compensation ratios. This research will be of enormous environmental and economic value to aquatic resource managers and industry professionals alike, and be a catalyst to create greater synergy between environmental and economic interests. (Poster)

Thomas, K.* , Chambers, P., Yates, A. Environment and Climate Change Canada. **Setting nutrient thresholds to protect stream water quality and ecological condition.** Inputs of nutrients, primarily phosphorus (P) and nitrogen (N), to rivers has resulted in eutrophication of surface waters, leading to impaired water quality (drinking water and recreational uses) and decreased ecological functioning. The goal of this study was to develop nutrient criteria for tributaries of Lake Erie in order to inform management decisions regarding control of nutrients (N & P) in agriculturally dominated watersheds, as well as to provide tools to track ecosystem recovery. We integrated results from multiple metrics measuring both the structure and function of biological communities and ecosystems in order to arrive at an ecologically meaningful threshold for nutrients (TN, TP, DIN & SRP). We also assessed whether simple individual metrics (e.g., percentage of organisms in a sample) responded in a similar manner to more complex approaches (e.g., an integrated metric such as TITAN or biological index) in order to provide management agencies with cost-effective assessment tools. Samples were collected April

through November 2012 from 29 streams in Lakes Erie and Huron watersheds, with preliminary analyses identifying TP concentrations of 40 - 100 µg/L as protective of stream ecological condition. These results will inform management decisions in the control of inputs of nutrients and can be used to model current and future compliance to identify watersheds of concern. (Oral)

Thomas, S.M.*, Melles, S.J., Bhavasar, S.B. Ryerson University, Toronto. **Unraveling the direct and indirect effects of climate and land-use on fish mercury levels using Structural Equation Models.** Sport fishes at the apex of aquatic food-chains are indicators of mercury pollution in freshwater ecosystems. However, given the differences in lake water chemistry, watershed landscape conditions and climatic factors, fish mercury levels tend to vary substantially across lakes. Not surprisingly, studies have struggled to fully comprehend the complex nature of mercury accumulation in fishes, especially when it involves multiple lakes across a heterogeneous landscape. To address this issue, we carry out a broad-scale study that integrates several disparate sources of information (Walleye mercury and body size, lake water chemistry, GIS derived lakeshed landscape composition and hydrological data, and climate) within a structural equation modeling (SEM) framework. A conceptual meta-model was constructed, where fish mercury level is hypothesized to be mostly driven by the direct effects of variation in fish mass and lake water chemistry variables. We further hypothesized that lakeshed land-use/cover and climate affects mercury levels both directly and indirectly. SEM results showed significant direct effect of lake water chemistry (especially DOC, PH, and Phosphorus), besides Walleye mass. Interestingly, lakeshed land-use/cover and climate have strong indirect effects via water chemistry that assume complex contrasting paths. Finally, latitude and lake order was also showed important indirect effects suggesting geographic and hydrological location of lakes also matter. The study sheds light on the role of land-use/cover conditions and climate as drivers of mercury contamination in freshwater fishes. (Oral)

Thorstensen, M.*; Jeffries, K. University of Manitoba. **Plasticity, selection, and ions: How an estuarine fish is coping with increasing salinity.** Adapting to increased salinity is critical for estuarine fish populations faced with changing environments. The Sacramento splittail, *Pogonichthys macrolepidotus* is one such species, where human and climate-driven influences have altered the salinity dynamics in rearing habitats for two populations in the San Francisco Estuary, USA. The San Pablo population is more salinity tolerant than the Central Valley population, therefore we compared the transcriptomic profiles of wild-caught fish from both populations challenged with salinity to investigate mechanisms underlying salinity tolerance. Furthermore, we called SNP's from the transcriptome to observe population differences in terms of selection and genomic variation. Here, we focus on a possible relationship between positive or directional selection and differential expression. Most transcripts exhibit phenotypic plasticity in the form of differential expression, or directional selection in the form of genetic variation, but not both. Of the transcripts that do show both selection and phenotypic plasticity, many represent processes involved in cellular remodeling and ion transport. These results elucidate an interplay between phenotypic plasticity and selection, along with possible mechanisms for adaptation to an increasingly saline environment in the Sacramento splittail. (Poster)

Timusk, E.R.*, Smokorowski, K.E., Armanini, D.G. Fisheries and Oceans Canada. **Benthic invertebrate flow sensitivity as a tool to detect biologically meaningful flow alteration in a regulated river in northern Ontario.** The majority of the Northern Hemisphere's rivers are fragmented by dams, altering, among other things, the natural flow regime. Peaking hydroelectric facilities greatly alter the natural flow regime and have been shown to have a number of effects on downstream biota. However, not all changes to the natural flow regime are ecologically relevant. The Canadian Ecological Flow Index (CEFI) has shown promise in identifying ecologically relevant changes in flow regime using benthic invertebrates. We attempt to address the impact of a peaking flow regime on benthic invertebrates using CEFI. Previous research used CEFI to investigate the impact of peaking on benthic invertebrates over a 6 year period on two proximate rivers on the northeast shore of Lake Superior using a Before-After/Control-Impact (BACI) design. Significant changes in the relative abundance of CEFI sensitive and generalist taxa were observed and hydrological variables associated with changes in CEFI were identified. With an additional 9 years of invertebrate data we revisit the CEFI analyses in order to confirm whether the effect on CEFI was sustained and to further explore which aspects of the flow regime are most critical to the flow-invertebrate relationship. (Oral)

Trumpickas, J.*, Dunlop, E.S. Ontario Ministry of Natural Resources and Forestry. **Effects of vessel and trawl noise on acoustic fish density estimates.** Integrated acoustic and netting surveys are conducted in marine and freshwater environments to assess the status of valuable fisheries resources and study fish population dynamics. Since 2014, annual acoustic and netting surveys have been conducted in Parry Sound, a coastal embayment in Georgian Bay, Lake Huron. Parry Sound supports one of the lake's few rehabilitated native lake trout populations as well as abundant pelagic prey fish including alewife, rainbow smelt, cisco, and round goby. In 2014-2017, fisheries acoustic surveys were run with 3 frequencies (38 kHz; 120 kHz; 333 kHz) while intermittently running pelagic trawls from the same 56 foot vessel. In 2017, a simultaneous survey was conducted from a second 26 foot vessel with a 120 kHz transducer. Effects of noise from the larger vessel and from trawl operation were analyzed by comparing: (1) Density estimates between vessels; (2) Density estimates with and without operation of a pelagic trawl. This work evaluates potential bias in fishery independent surveys and will aid in the development of integrated monitoring programs in coastal zones of large freshwater ecosystems. (Oral)

Tuononen, E.I.*, Smokorowski, K.E., Timusk, E.R., S.J. Cooke. Carleton University. **Fish community interactions with very low head hydroelectric turbine technology.** Very low head (VLH) turbines are a relatively new technology for hydropower generation and are often touted as being "fish friendly" for entrained fish. With growing interest in deploying such technology in Canada, there is a need for biological assessments to understand how fish interact with VLH turbines. We initiated a study to assess the potential biological consequences of VLH turbines on fish, at the only VLH turbines in Canada located on the Severn River, Ontario. Here we assess risk based on the potential for fish to become entrained through movement around the turbines, and the specific injury and mortality rates resulting from entrainment. To determine the risk of entrainment we tagged 138 fish with acoustic telemetry transmitters to track

movements around the turbines, enabling us to determine which species and size classes are most likely to become entrained, and their subsequent fate. To determine turbine specific injury and mortality rates, we experimentally introduced fish into the turbines and then subsequently recaptured fish downstream. Using before and after entrainment assessments we can determine injury and mortality rates. These results will provide evidence towards the “fish friendly” nature of the turbines, and the management implications of their potential installation across Canada. (Oral)

Turko, A.J.*; Nolan, C.B.; Pitcher, T.E. Great Lakes Institute for Environmental Research.

Thermal tolerance across age, sex, and season in endangered redbreasted dace *Clinostomus elongatus*. Urbanization typically increases water temperatures in streams and rivers via decreased canopy cover and warming of stormwater runoff. Increased temperature is hypothesized to be a major contributor to the decline of many species at risk, including the redbreasted dace *Clinostomus elongatus*, but data are lacking. Redbreasted dace populations are at risk through much of their range (listed endangered in Canada), but healthy populations remain in Ohio. We are studying these robust Ohio populations to determine acute thermal tolerance (CT_{max}) of juvenile and adult fish throughout an annual cycle to inform Canadian recovery efforts. During the summer (stream temperature ~22°C), CT_{max} was significantly higher in juveniles (35.5°C) than adults (34.5°C). Within juveniles, CT_{max} was positively correlated with body mass, but within adults this relationship was negative. Body condition (Fulton’s K) was not related to CT_{max}. These results indicate that, during peak summer temperatures, the largest adult redbreasted dace are the most thermally sensitive. Temperatures in historic redbreasted dace habitat in southern Ontario can approach the CT_{max} values we measured when pavement-warmed stormwater is discharged directly to streams. Thus, our data suggest that restoration strategies that lower water temperatures in these streams should be emphasized. (Poster)

Turko, A.J.*; Wright, P.A. Great Lakes Institute for Environmental Research. **Gill filament calcification: a mechanism to enhance fish respiratory function?** The structure and function of fish gills is closely linked to natural history and can influence how fishes respond to environmental challenges. The factors that influence gill surface area are well-studied, but the mechanical properties of gill tissues and how these determine function are not well understood. In several groups of fishes, the bases of the gill filaments are stiffened by a calcified “sheath” of unknown function. We tested the hypothesis that calcified gill filaments enhance water flow through the gill basket, improving respiratory function. We surveyed >100 species of fishes and found that species with the most calcified filaments tended to be from hypoxia-tolerant families. Calcification of the gill filaments was widespread in Perciform fishes, but largely absent in other teleost clades (e.g. Cyprinids, Salmonids). In two model species, the killifish *Kryptolebias marmoratus* and the guppy *Poecilia wingei*, acclimation to hypoxia or warm temperatures (to increase respiratory demands) increased calcium deposition on the gill filaments. Finally, experimental decalcification decreased the resistance of the gill basket to water flow, indicating that respiratory surfaces were bypassed. Overall, these results indicate that the mechanical properties of gill filaments may be an important mechanism that determines respiratory function of fishes. (Oral)

Turner, N.*; Rennie, M.; Enders, E.; Watkinson, D.; Klein, G.; Charles, C. Lakehead University. **Walleye (*Sander vitreus*) movement ecology in Lake Winnipeg, Canada: past and present.** Over the past century Lake Winnipeg has been subjected to general declines in water quality with increased nutrient inputs, establishment of invasive species, and increased commercial fishing pressure. Morphologically, the lake has two distinct basins (North and South) connected by a narrow channel. The basins differ in size, depth, clarity, temperature, and species composition. Commercial fishing activity has been ongoing in the lake since 1883, Walleye being a primary target species. To date, Walleye movement has been studied at the genetic level only, with contrasting conclusions as to whether separate populations exist within the lake. This study will use historical mark-recapture data from the 1950s, 1970s, and current acoustic telemetry data to determine Walleye movement among different Walleye size classes, between basins, and subsequent changes in movement over time. Preliminary data analysis indicates some intermixing between the North, channel, and South basins occurred historically, with a maximum extent of ~300 km between initial tagging and recapture locations. This research will ultimately aid in the development of scientific-based and sustainable policy and regulation for both the commercial and recreational Walleye fishery in Lake Winnipeg. (Poster)

Venturelli, P.V.*. Ball State University, United States. **Have your fire hose and drink from it, too: an expert-approved approach to using angler apps to generate large volumes of usable data.** Angler smartphone applications (apps) are potentially valuable sources of conventional and novel fisheries data. However, realizing this potential requires standards for ensuring a large, reliable, and usable data stream. To this end, we convened a workshop of representatives from 11 angler apps, and 22 experts in recreational fisheries, human dimensions, economics, data management, citizen science, and standards. Participants identified gaps between the data that fisheries need and apps are generating, and propose a prioritized set of standards for data collection. The consensus among participants was that these standards should be maintained by a science-based and international standards council. This council should also maintain a repository of participating angler apps (including which standards they meet, the amount of data that they have, and for which locations), and any data that participating apps are willing to share. Access to these data will be controlled by the standards council, and in accordance with terms that have been set out by each participating app. (Oral)

Walton-Rabideau, S.E.*; Ledee, E.J.I., Leblanc, J.P., Szekeres, P., Midwood, J., Gallagher, A.J., Farrell, J.M. and Cooke, S.J. Carleton University. **Seasonal spatial ecology of juvenile muskellunge and northern piker in St. Lawrence River nursery bays.** Exploring the spatial ecology of juvenile fish is necessary to interpret earlier life history strategies, delineate core habitats, and appropriately manage populations. While nursery habitat requirements for age zero esocids in the St. Lawrence River are well understood, little is known about the influence of physical habitat on residency, behaviour, and survival during fall dispersal and overwintering periods. To that end, we captured age-0 Muskellunge (*Esox masquinogy*) and Northern Pike (*Esox lucius*) in known nursery bays between August and October and implanted them with the smallest, commercially-available acoustic transmitters, known as JSAT tags. Detection data, modeled against environmental covariates, suggests juvenile esocids are resident in early fall then expand along the shoreline as waters cool. Both species tended to use regions that

supported growth of submergent aquatic vegetation; however, whilst resident, the fish like exposed shallow areas. A complementary hatchery study, which evaluated retention of JSAT tags, associated survival, growth, and healing of surgical wounds on age zero Muskellunge, found neither tag expulsion nor mortality associated with surgical procedures. Telemetry was found an effective tool to study wild juvenile esocids, and evaluating fine-scale water column depth use in a shared habitat may reveal distinct realized environmental niches. (Oral)

Warne, C.P.K.*; Rooney, N.; McCann, K.S. University of Guelph. **Testing for warming-induced shifts in body size for cold-water fish.** Climate warming since the 1950s has greatly outpaced trends during previous millenia, causing lake water temperatures to increase and threatening the biota living in these systems. Growing evidence suggests that average and maximal body size for fish is decreasing over time in response to warming waters, having implications ranging from fisheries production, population sustainability and ecosystem functioning. However, we lack a clear understanding of how widespread these declines in fish body size are and of the mechanisms fueling them. Here, we used historical (1959-2006) size at age catch data for various lakes across Ontario to quantify changes in the size structure of two important cold-adapted freshwater fish; lake trout (*Salvelinus namaycush*) and lake whitefish (*Coregonus clupeaformis*) over time. We then relate these changes in size structure to physical characteristics and climate trends specific to each study lake. (Oral)

Warriner, T.R.*; Love, O.P.; Pitcher, T.E.; Semeniuk, C.A.D. University of Windsor. **Fish in hot water: Maternal stress may prepare juvenile Chinook salmon offspring to behaviourally cope under climate change.** Climate change is increasing global water temperatures, and by altering temperature regimes, is subsequently impacting aquatic life, particularly ectothermic fish. When mothers encounter environmental stressors such as elevated temperatures during follicular recruitment (maternal stress), resultant offspring often have altered phenotypes. Although these effects are often considered negative, recent studies suggest this maternal stress signal may prepare offspring for a similarly stressful environment (environmental match). We applied the environmental match hypothesis to investigate whether a maternal stress signal can prepare offspring to behaviourally cope in a stressful environment. Specifically, we exposed Lake Ontario Chinook salmon (*Oncorhynchus tshawytscha*) eggs to a biologically relevant maternal stress signal (1000ng/mL cortisol or control). We then split and reared these dosed groups at temperatures indicative of current and future temperature conditions (+3°C). By testing offspring behavioural responses to novel shelter and predator stimulus tasks, we tested the hypothesis that offspring exposed to maternal stress should exhibit more routine rather than flexible behaviours in elevated temperatures as an energetic cost-saving strategy. By examining an ecologically and commercially important fish within the environmentally relevant context of climate change, our results should facilitate predictions of how fish and hence fisheries persist with increased water temperatures under projected climate scenarios. (Oral)

Weir, L.K.* and Young, K.A. Saint Mary's University. **Sexual selection and alternative mating strategies in salmonid fishes.** In many species of salmonids, alternative male mating phenotypes with markedly different life histories can occur. These fish are often characterized

as large “fighter” and small “sneaker” or “jack” males. Alternative male mating phenotypes are typically thought to occur in salmonid populations at evolutionarily stable frequencies. The co-occurrence of these two strategies can influence the action of sexual selection, whereby the presence of jacks can affect the distribution and variance of individual fighter male mating and reproductive success. Using multi-year datasets for *Oncorhynchus* populations on the Pacific coast of North America, we explore how frequency-dependent selection can impact the abundance of fighter and jack males, and carry out inter-population comparisons to assess the degree to which jack frequency can affect an important sexually-selected trait, body size, in fighter males. As predicted under a mixed evolutionarily stable strategy, an increase in the abundance of fighter males corresponds with a decrease in jack frequency. We also test the prediction that a decrease in the abundance of jacks will result in an increase in fighter body size due to more intense sexual selection within fighter males when they occur in populations at relatively high frequencies. (Oral)

Wells Z.R.R.^, Bernos T.A.^*, Yates M.C., Fraser D.J. (^Authors with equal contribution; * Author presenting). Concordia University (Present affiliation: University of Toronto). **Population hybridization outcomes are unrelated to population size and population divergence in Brook Trout.** Although hybridization can be used as a tool for genetic rescue, it can also generate undesirable effects, including outbreeding depression and a reduction of local adaptation. Hence it is important to identify predictors of hybridization outcomes to better inform decision-makers on when and where to adopt hybridization as a conservation tool. We investigated how multiple factors (effective population size, quantitative genetic divergence, and environmental dissimilarity in pH, temperature) influence hybridization outcomes in Brook Trout (*Salvelinus fontinalis*). Our common garden experiment compared three early life stage fitness-related traits (survival and length) among 19 F1 hybrid cross-types versus pure crosses (395 total families) from eight populations varying in effective population size (range = 44-589). Although several factors significantly influenced fitness-related traits, relationships were biologically weak and non-synergistic amongst traits. Furthermore, the positive and negative effects of hybridization varied widely amongst families within populations: only weak indications of fitness gains from hybridization were observed in small populations, and the benefits of hybridization were decreased or lost under stressful environmental conditions. These results suggest that hybridization outcomes might be hard to predict at the population-level and thereby reinforce a precautionary approach when dealing with the genetic management of small populations. (Oral)

Wiens, L.M.*; Jeffrey, J.D.; Enders, E.C.; Jeffries, K.M.; Treberg, J.R. University of Manitoba. **Metabolic profiling of walleye (*Sander vitreus*) blood from the Lake Winnipeg basin suggests regional differences in nutritional status.** Walleye are an important part of the Manitoba commercial and recreational fishery. The aim of this study was to test if non-lethal sampling may provide insight into regional differences in nutritional status or environmental stress, both of which may be crucial to regional growth and production dynamics. Walleye were captured from five locations in the Lake Winnipeg basin, Manitoba, as part of a Fisheries and Oceans Canada Fish Movement Tracking Study. Blood sample analysis was based on a targeted metabolomics approach using both nuclear magnetic resonance (NMR) and direct flow mass-

spectroscopy. Initial results, analyzed by Principal Component Analysis, show separation along capture sites, suggesting metabolic profiles may differ across regions. For example, essential amino acids, Krebs cycle intermediates, are low in the most southern region sampled, whereas choline metabolites (important to lipid and neurotransmitter metabolism) are low in the most northern region sampled. Importantly, the metabolite profiles do not parallel regional differences in condition factor. Therefore, length-weight relationships may be missing underlying differences on metabolic status. Our preliminary results suggest non-lethal sampling for targeted metabolite analysis shows promise as a tool for evaluation of nutritional status of fishes in the wild. (Poster)

Wilson, C.C.*, Burness, G. Ontario Ministry of Natural Resources and Forestry. **Coldwater species in a warming world: challenges for sustainable management.** Changing environmental conditions related to global warming pose multiple challenges to freshwater fish species, particularly cold-adapted stenotherms. Lake trout and brook trout, two iconic coldwater species that support significant fisheries, face multiple climate change-related challenges. Although both species are closely associated with coldwater habitats, they show marked differences in thermal physiology and performance: both species show phenological plasticity as well as heritable components for reproductive timing, but exhibit contrasting patterns of variation in response to acute thermal stress within and among populations. Variation in thermal performance and scope for activity within and among brook trout populations contrasts sharply with the limited variation exhibited by lake trout, and may reflect the respective habitat variability vs stability for the two species. The species similarly differ in the potential efficacy of facilitated gene flow to augment the adaptive potential of wild populations for climate change-related stresses. Current research is investigating potential transgenerational effects of environmental temperatures experienced by adults on thermal physiology in both species. Sustainable management of both species will require recognizing and mitigating climate-related challenges to help ensure the viability of these iconic species as well as the fisheries they support. (Oral)

Wisenden, B.D. Minnesota State University Moorhead, USA. **Co-evolution of parental care and antipredator competence in convict cichlids.** Parental care in fishes evolved, in part, in response to selection favouring defence of offspring from predators. Therefore, there is a three-way co-evolutionary interaction among parental care, antipredator competence of the offspring, and brood predation. Convict cichlids are neotropical fish with biparental care. Field populations of convict cichlids in Costa Rican (CR) streams and a volcanic crater lake in Nicaragua (NI) co-exist with different communities of brood predators, of note is the presence of the sleeping goby *Gobiomorus dormitor* in the NI site but its absence in the CR site. Swimming speed of larvae undergoes a rapid improvement at 7 mm in CR but not until 8-9 mm in NI fish. This shift in swimming performance coincides with rapid ossification of the skeleton in each population. Concomitantly, the radius of the brood expands as the young grow in CR, plateauing at 6.5 mm, at the most common radius of parental attack against intruders. In NI, where *G. dormitor* specializes on cichlid larvae, young cichlids remain close to their natal cave until they reach 8 mm before expanding their foraging area. These data support the hypothesis

for a three-way co-evolution of larval development, brood predation and parental brood defence. (Oral)

Wynia, A.G.*; Midwood, J.D.; Reddick, D.T.; Jacobs, C.R.; Doka, S.E.; Whillans, T.H. Trent University. **Fish and invertebrate use of invasive Phragmites in a Great Lakes freshwater delta.** As a result of climate change and human disturbance, Invasive *Phragmites australis* ssp. *australis* (herein “Phragmites”) has established and rapidly spread throughout many coastal areas of the Great Lakes. In several locations it has displaced native emergent species potentially changing spawning, nursery and foraging habitat for fishes and aquatic invertebrates. The extent to which Phragmites provides habitat for fish and invertebrates in freshwater marshes is currently unquantified, although widely suspected to be unsuitable. This study assessed whether fish and aquatic invertebrate assemblages in stands of Phragmites differ from those in stands of two native emergent vegetation types, *Typha* spp. and *Schoenoplectus* spp. in the St. Clair River Delta. Habitat data were collected concurrently to help identify potential drivers that may influence differences in richness and assemblage. The results of this study indicate that Phragmites provides habitat that differs significantly from native emergent vegetation types in terms of stem density, water quality, and water depth. However, no differences were detected in fish and invertebrate assemblages between Phragmites and native emergent vegetation types. The findings of this study suggest that Phragmites is ecologically valuable in the provision of fish habitat in freshwater marshes, and should be managed accordingly. (Poster)

Yates, M.C.*; Bowles, E.; Fraser, D.J. Concordia University. **Experimental vertebrate translocations reveal the relative importance of habitat and population genetic risks in novel environments.** Little empirical work in nature has quantified the relative importance of habitat versus genetic risks (e.g. habitat degradation, low genetic diversity or small population size) to population persistence when exposed to novel environmental conditions. To test how populations vary in their response to novel environmental change, juvenile brook trout (*Salvelinus fontinalis*) from 12 isolated populations or closed metapopulations that differ in population size and genetic diversity by orders of magnitude were transplanted to novel, fishless ponds that represented a wide gradient of ecologically important variables. We evaluated the effect of genome-wide variation, effective population size (N_e), pond habitat, and initial body size on two fitness correlates (survival and growth). Genetic variables had little effect on either fitness correlate, which were determined primarily by habitat (pond temperature, depth, and pH) and body mass. Some vertebrate populations with low genomic variation and N_e may therefore retain the capacity to tolerate novel environmental change despite being isolated, in some cases, for thousands of years. Our results suggest that small, low-diversity populations can represent important sources of variation that may be capable of maintaining fitness in, and ultimately persisting and adapting to, changing environments. Our results also reinforce the importance of improving available habitat and slowing habitat degradation to species conservation. (Oral)

Yates, M.C.*; Fraser, D.J.; Derry, A.M. UQAM; Concordia University. **Meta-analysis supports further refinement of eDNA for monitoring aquatic species-specific abundance in nature.**

Environmental DNA (eDNA) has the potential to be a powerful new molecular tool through which organism abundance can be quantified. The use of eDNA to detect the presence/absence of rare or invasive species is well documented and its use in biodiversity monitoring is expanding. Preliminary laboratory research has also shown a positive correlation between the concentration of species-specific eDNA particles and the density/biomass of a species in a given environment. However, the extent to which these results can be extended to natural environments has yet to be formally quantified. We collated data from experiments that examined the correlation between eDNA and two metrics of abundance (biomass and density) and, using mixed-effects meta-analysis, quantified the strength of that correlation across laboratory and natural environments. We found that eDNA particle concentration was more strongly correlated with abundance in laboratory environments compared to natural environments, accounting for approximately 82% and 57% of the observed variation in abundance, respectively. No effect of abundance metric was found on the strength of correlation between eDNA particle concentration and abundance. Despite a weaker general correlation in natural environments, eDNA often still explained substantial variation in abundance. eDNA research is still in its infancy; with only moderate improvements in technology or technique, it could represent a powerful new tool for quantifying abundance. (Oral)

Zhu, X. Fisheries and Oceans Canada & Freshwater Institute, Winnipeg, MB. **Elucidation of synergistic impacts of climate changes and regional anthropogenic disturbance on arctic great lake ecosystems.** Great Slave Lake (GSL), one of arctic great lakes, entirely situates in the Northwest Territories, Canada, and is listed as the 9th largest lakes in the world, the deepest lake in North America and typically oligotrophic lake in arctic. Despite of being ecological importance, it becomes substantially under-studied how the seasonal changes of nutrient transports and discharge have complicated with GSL biological processes and fisheries production. Historically, GSL has long sustained the largest commercial fisheries in the Northwest Territories and most important subsistence resources for indigenous communities around the lake. Associated with multiple vectors of internal and external effects, we developed a hierarchical analytical framework to elucidate synergetic impacts of anthropogenic disturbance on GSL ecosystem. In terms of field investigation in the southern GSL in summers 2011-2018, three hierarchies of ecological interactions, species richness and diversity, spatiotemporal dynamics of biological characteristics and association of fish community with changing of limnology parameters, have been addressed. Among the total twenty-four fish species identified, the lake is dominated by three Coregonid fishes, Lake Whitefish, Cisco and Least Cisco. Multivariate analyses, including cluster analysis and canonical correspondence analysis, revealed that depth and temperature were important environmental variables dictating the spatiotemporal dynamics and predator-prey relationships of the multispecies biological production in the lake. There may be other abiotic variables or biological components that need to be integrated into future monitoring, but these preliminary results highlight the significance of monitoring environmental and cumulative impacts mixed with aquatic climate changes and anthropogenic activities. (Oral)

CCFFR/SCL 2019 by Gender

