SCAS 2024 ABSTRACT BOOK

Moving from biomass based towards a toxin-based warning system in Dutch bathing sites

Els Faassen[1]

[1]Wageningen University and Research

In the Netherlands, official bathing sites are monitored for the presence of cyanobacteria. When the density of potentially toxic species is high, the authorities advice not to swim. Using cyanobacterial biomass as an indicator for the actual risk of toxin exposure is, however, inaccurate. Therefore, we are working on a toxin based monitoring and warning system. When this process started, communication between water managers and scientists was poor and there was little consensus between water managers. Also, there were no guidelines for toxins other than microcystins and toxin analysis could only be performed by specialized labs. Therefore, communication between water managers, stakeholders and scientists was increased and structured, and water managers and scientific institutes jointly performed a study on different monitoring strategies. From this common ground, we proceeded with thoroughly evaluating available rapid tests for reliability, throughput and costs. Next, water labs and scientists have jointly developed protocols so water managers can test for the major groups of toxins without relying on external labs. We will present how patience, communication, cooperation, and scientific data were critical aspects in this process and how we hope to proceed.

Affiliation

Wageningen University and Research

Presentation type

Oral

Identification and Quantitation of Cyanotoxins in Atlantic Canadian Fresh Waters

Daniel Beach[1], Lydia Zamlynny[2], Christopher Miles[1], Krista Thomas[1], Elliott Wright[1], Diego Laquintana Alonso[3], Lindsay Johnston[2], Xavier Ortiz Almirall[3], Meghann Bruce[4], Rob Jamieson[2], Pearse McCarron[1]

[1]Biotoxin Metrology, National Research Council, Halifax, NS, [2]Centre for Water Resource Studies, Dalhousie University, Halifax, NS, [3]IQS School of Engineering, Universitat Ramon Llull, Barcelonia, Spain, [4]Canadian Rivers Insitute, University of New Brunswick, Fredericton, NB

here has been increased concern about cyanobacterial blooms and their toxins in Atlantic Canada in recent years due to canine mortalities, closure of supervised beaches and blooms in drinking water reservoirs. Accurate and comprehensive analysis of cyanotoxins in water and cyanobacteria is important in enabling response to animal fatalities, assessment of risk and research into the occurrence and drivers of toxic blooms in the region. However, cyanotoxin analysis remains challenging because of the varying chemical properties of different classes (e.g. anatoxins, microcystins, saxitoxins), the large number of structural analogues within each class and the complex samples in which they occur. Here, we present a toolbox of methods developed for the analysis of cyanotoxins, giving examples of how they have been applied recently in Atlantic Canada. Preliminary screening of environmental samples uses a multi-class HILIC-MS/MS method capable of detecting all main classes of cyanotoxins. A rapid screening method for anatoxins by direct analysis in real time has been valuable in the detailed study of highly variable anatoxin production in benthic cyanobacteria in the Wolastoq. The broader extent of cyanotoxin occurrence in the region has been investigated using passive samplers designed to give time-averaged measures of toxin occurrence, helping to target research efforts to impacted areas. Non-target analysis using high resolution mass spectrometry has revealed several new anatoxins not detected by conventional methods, which in some cases make up a significant proportion of the total toxin detected. Challenges and future needs for improved analytical capabilities in the field will also be discussed.

Affiliation

National Research Council

Presentation type

Oral

Maw-lukwuti’k: Mobilizing Different Knowledge Systems for Collaboration

Atlantic salmon, Salmo salar, is an important species in Atlantic Canada that supports Indigenous and non-Indigenous fisheries. Understanding when and where salmon migrate are important considerations for offshore developments, such as oil and gas, that could have impacts on salmon populations. Since 2021, a large-scale study to further understand Atlantic salmon migratory patterns has been underway to inform decision-making in Canada. Given the magnitude of the study area and breadth of experience needed to tag salmon within a short period of time, a unique collaboration of federal, provincial, Indigenous, and academic scientists, as well as Indigenous and non-Indigenous partners are working together to share expertise, training opportunities, and transfer knowledge to ensure success of the project and inform the protection of salmon. While the project is largely focused in Western Science, the role of Indigenous knowledge was key to co-design studies and focus the project. This project provides examples of how Indigenous knowledge is important to inform relations, methods, and mobilize different knowledge systems.

Presentation type

Oral

Indigenous Partnered Research Addressing Biodiversity Knowledge Gaps and Community Ecosystem Concerns in the Inuvialuit Settlement Region

Jordan Musetta-Lambert[1], Kirt Ruben[1], Max Kotokak Sr[1], Lennie Emaghok[1], Joshua Teddy[1], Borge Aery[1], Joseph Culp[1]

[1]Environment and Climate Change Canada

Arctic freshwaters and their unique biodiversity are facing rapidly changing environmental conditions because of modified physical and chemical properties of freshwater systems. In part, these changes are caused by permafrost thaw, human development, range expansion of ecosystem engineers and southern species, changes to precipitation, hydrological processes, and ice cover dynamics. In this case study, we have conducted targeted research that addresses evolving community concerns as outlined by local Hunter and Trapper Committees and regional community organizations while using standardized tools and protocols that can contribute sufficiently high-resolution data to build a biodiversity monitoring program to track temporal change. Community concerns included the effects of the Inuvik-Tuktoyaktuk Highway on stream ecosystem integrity and have evolved to understanding impacts on streams related to beaver range expansion. This collaborative research has been ongoing since 2019 across all non-ephemeral streams with road crossings along the Inuvik-Tuktoyaktuk Highway. Recently, the sites have (circa 2022) been extended to stream locations further inland (to target beaver impoundments across watersheds) and streams draining into the Imaryuk (Husky Lakes), a culturally important lake system and fishing area. Here, we will discuss co-developed study design and coordination of goals, initial results of our temporal exploration of the biodiversity data, and results that cover the effects of road development on tundra stream ecosystems. In addition, we will describe next steps that will enhance the overall scope of biodiversity data to include further understanding of the terrestrial-aquatic interface.

Affiliation

Environment and Climate Change Canada

Presentation type

Oral

Small scale, small fish, big implications: linking ecology, evolution, and genetics of Cape Race brook trout populations

Dylan Fraser[1], Brian Gallagher[1], Jean-Michel Matte[1], Matthew Yates[1], Jacquelyn Wood[1], Thais Bernos[1], Carol Zastavniouk[1], Zachery Wells[1], Paul Debes[1], Hyung-Bae Jeon[1], Johnathan Lemay[1], Sofia D'Angelo[1], James Grant[1]

[1]Concordia University

Bridging the study of ecology, evolution and genetics in wild populations is critical for forecasting species responses to environmental change. Yet, we often lack such integrative research on the same populations despite its importance to informed management. Furthermore, the large scale of many systems and short duration of funding cycles often makes such integrative research unattainable. Here, we describe a long-term research program where diverse facets of population biology have been investigated in numerous isolated populations of brook trout inhabiting small streams (~0.3-4km in length) in Cape Race, Newfoundland. First studied by Jeff Hutchings in the late 1980s, the focal populations occupy a small area (~100 km^2) with few human impacts, are genetically differentiated, can be comprehensively sampled, experience a similar climate, and are amenable to common garden experimentation. Since Jeff's initial pioneering exploration, Cape Race brook trout have formed the basis for diverse empirical studies of life history evolution, density dependence, and the role of plasticity, genetic diversity, and effective population size as drivers of adaptive responses to environmental change. Overall, Cape Race brook trout demonstrate that small-scale habitat variation and population diversity in demographics and genetics play significant roles in moderating species responses to environmental change, as well as in generating portfolio effects. This complexity is likely present in many species, and raises a conundrum for management: if a thorough understanding of population diversity is not routinely achievable, what do we risk by applying uniform management measures across populations?

Affiliation

Concordia University

Presentation type

Oral

A STREAM-lined approach for freshwater biodiversity assessment in Canada

Michael Wright[1], Mehrdad Hajibabaei[1], Teresita M. Porter[1], Donald J Baird[2], Wendy Monk[2]

[1]University of Guelph, Centre for Biodiversity Genomics, [2]Environment and Climate Change Canada & University of New Brunswick

In the face of the biodiversity decline resulting from climate change and other local and regional factors, it is imperative to adopt broadly applicable methods for collecting high-quality data on a large scale. The STREAM (Sequencing the Rivers for Environmental Assessment and Monitoring; www.stream-dna.com) program integrates standardized training, kick-net sampling, community-based monitoring, and the 'Biomonitoring 2.0' method of environmental DNA metabarcoding, which together facilitates the rapid, high-resolution identification of freshwater benthic macroinvertebrates that can be used in routine environmental assessment.

Since STREAM's inception in 2019, more than 350 participants, including individuals from local watershed groups, NGOs, academia, and Indigenous communities, have undergone training. They have collectively gathered over 2000 samples from across Canada. Through STREAM, community groups can leverage the data generated through STREAM to elevate their efforts in aquatic ecosystem management, conservation, and restoration.

Here we will give a brief update on the STREAM program's structure, give a broad summary of the first five years of results at the national level, and share how some community groups are combining the biodiversity data from STREAM with other information sources to explore local questions of significance to them. As the number of participants and organizations collecting benthic data through STREAM continues to grow, it will enable broader inference, unlocking new possibilities for analyses using the existing biodiversity and DNA sequence data generated through STREAM.

Affiliation

University of Guelph

Presentation type

Oral

Exploration of the Trophic Pathways of Mercury into Eastern Ontario's bats

In Eastern Ontario, the little brown myotis (*Myotis lucifugus*) and the big brown bat (*Eptesicus fuscus*) have repeatedly been found with levels of mercury exceeding proposed sub-lethal toxicity thresholds, but questions remain regarding how exactly this occurs. Given that bats are thought to be exposed to mercury primarily through their diet, numerous other studies indicate that a greater reliance on emergent aquatic insects should increase the likelihood of mercury exposure: however, this does not appear to be the case for *M. lucifugus* and *E. fuscus* in this region of Ontario. From May to September of 2022, a total of 220 individual bat fur samples, 13 bat colony guano samples and 224 prey insect samples were collected from 12 sites in the Eastern Ontario region. Bat fur and insects have been analyzed for total mercury, as well as stable isotopes of carbon and nitrogen in order to characterize contamination sources and long-term diet; meanwhile, DNA metabarcoding of colony guano samples has been used to confirm the importance of particular prey taxa. Median fur mercury values for adult big brown bats (n=40) exceed the proposed 10μg/g mercury threshold for sub-lethal effects; that of little brown bats (n=123) is significantly lower, despite initial MixSIAR stable isotope models indicating that little brown bats rely much more heavily on emergent aquatic prey. This study aims to explore and clarify the trophic pathways that expose this terrestrial apex predator to environmental mercury contamination.

Affiliation

Carleton University

Presentation type

Oral

Developing and Validating Universal eDNA Metabarcoding Primers for Enhancing Freshwater Fish Diversity Assessment

Environmental DNA (eDNA) is routinely employed for quantifying aquatic species diversity, primarily through eDNA metabarcoding, using “universal” PCR primers to amplify target DNAs, with species identification via high-throughput sequencing. However, the DNA sequence for specific gene regions can be almost identically shared by closely related fish species, constraining the taxonomic resolution of eDNA metabarcoding. To improve taxonomic resolution, we designed novel eDNA metabarcoding primers that target sequence fragments with significantly greater lengths (250-320 base pairs) than commonly used 100-150 base pair length targeted metabarcoding assays, expanding taxonomic resolution. Assessing both previously designed (PS1) and novel (FB1, CFI, M-Mifish, M-teleo) primers, we evaluated their ability to identify species richness and abundance. To validate primer amplification, we compiled a diverse list of 20 Canadian freshwater fish species, including lamprey, sturgeon, and major teleost groups. The assays effectively amplified diluted tissue DNA from targeted species, but lamprey exhibited limited amplification for some markers. To further assess marker performance, we conducted an experiment in which DNA from multiple species was spiked into eDNA extracted from samples collected from the Detroit River to create known “mock communities.” Mock communities varied in i) the number of species present (7 or 15 species) and (ii) the DNA concentrations across species. Primer sets were further tested on limited local waterway eDNA samples to compare their detection patterns. Validated metabarcoding assays herein will improve our capacity to detect and map fish species presence, thus facilitating the management and conservation of invasive, rare, endangered and exploited fish species.

Affiliation

University of Windsor, GLIER

Presentation type

Oral

Using eDNA to assess salmonid populations in aquatic environments of Prince Edward Island, Canada

Annie Dysart[1], Dr. Scott Roloson[2], Kyle Knysh[1], Dr. Michael van den Heuvel[1]

[1]University of Prince Edward Island, [2]Department of Fisheries and Oceans

Environmental DNA (eDNA) sampling is becoming a popular method to assess fish populations due to its non-invasive nature and high detection sensitivity. In aquatic systems, eDNA techniques have been successful in assessing the occurrence of target species. The current challenge for eDNA sampling is to effectively gather quantitative data for fish abundance indicators in a given area without having to enter the river. The concentration of DNA in an environment is influenced by factors such as water chemistry, flow, and temperature, which means that a quantitative relationship found with fish counts are region or even basin dependant. This project aims to create a baseline for the use of eDNA sampling as a quantitative method to survey fish populations in Prince Edward Island. eDNA sampling was paired with electrofishing in rivers across the province to assess brook trout (*Salvelinus fontinalis*) and Atlantic salmon (*Salmo salar*) populations. In addition, eDNA-only sampling of 62 rivers was conducted to establish species distributions across the province with molecular techniques, and certain sites may be used to validate the quantitative model generated from the electrofishing surveys. Molecular analysis was conducted using existing species-specific qPCR assays gathered from existing literature and tested for cross-amplification among co-occurring species before use. This research investigates eDNA techniques and best practices to integrate eDNA sampling as a quantitative technique into salmonid surveys.

Affiliation

University of Prince Edward Island

Presentation type

Oral

Thermal refuges, more than temperature? - Leveraging remote sensing and swimming cost models to gain insights into salmonid use of thermal refuges

Antóin M. O'Sullivan[1], Valerie Ouellet[2]

[1]University of New Brunswick, Canadian Rivers Institute, [2]Integrated Statistic inc. for NOAA Northeast Fisheries Science Center, Orono, Maine, USA

The study of thermal refuge use by salmonids has received considerable attention in the last two decades. Whilst these studies have provided insights into how these refuges can offset physiological stress, they have typically only focused on temperature. Focusing on Atlantic salmon (*Salmo salar* - AS) and brook trout (*Salvelinus fontinalis* - BKT), we ask (1) what are the benefits (measured by swimming cost) of having access to thermal refuges under varying temperature conditions? and (2) what conditions can offset the thermal relief benefit of using a thermal refuge? Integrating observational fish data, drone based thermal infrared imagers (main river 22 °C, 26.2 °C and 31.5 °C) and remote sensing derived velocity maps we construct a suite of swimming cost models. Our models found access to thermal refuges reduces swimming costs across all age classes of AS, but the greatest reduction was found in adult AS and large BKT, with a modelled swimming cost reduction of 150 %. The role of velocity in the thermal refuge was found to be greater than that of temperature. For adult AS (assumed to weigh 4.5 kg), increasing velocity in the refuge from 40 $cm \cdot s^{-1}$ to 65 $cm \cdot s^{-1}$ while keep temperature constant led to a modelled increase in swimming cost of ~ 418 %. We conclude by proposing fisheries managers and restoration practitioners begin to view thermal refuges not only as thermal refuges, but as "***bioenergetic refuges***" that include complex thermodynamic, hydrodynamic and biological interactions.

Affiliation

University of New Brunswick

Presentation type

Oral

Distribution of multiple genetic groups of Atlantic salmon (Salmo salar) in Canada's smallest province

Carissa Grove[1], Scott Roloson[2], Kyle Knysh[1], Scott Pavey[3], David Cairns[2], Robert Gilmour[4], Michael van den Heuvel[1]

[1]Canadian Rivers Institute, University of Prince Edward Island, [2]Department of Fisheries and Oceans, [3]Canadian Rivers Institute, University of New Brunswick (Saint John), [4]Sustainable Design Engineering, University of Prince Edward Island

Atlantic salmon (*Salmo salar*) has undergone population declines across its native range. In eastern Canada many regions are listed as special concern or endangered and stocking has often been used as a population recovery strategy. The risks of extensive stocking are becoming better understood especially it pertains to genetic diversity by increases admixture while decreasing differentiation between regions. In Prince Edward Island, Canada, stocking has occurred since 1880 and over 37 million salmon have been stocked. To assess population genetic composition on PEI, samples were collected from juvenile salmon in 21 rivers. Rivers were chosen based on past surveys indicating salmon presence. A panel of six microsatellites were used, followed by next generation sequencing to evaluate alleles. Bayesian clustering methods were used to determine groupings of rivers. Generally, rivers clustered by geographic region where distance between rivers accounted for 25.8% of the variation. Rivers in northeastern PEI were the most distinct and clustered separately across all methods. The rivers in this cluster represent most of the self-sustaining populations in the province. Stocking intensity was not indicative of differences between populations; however, historical records are incomplete. There are multiple stocks on PEI that may reflect biogeography and historic colonization post deglaciation, thus local adaptations may be present. As differences between populations become clearer better management strategies can be implemented to help conserve and enhance wild salmon populations on PEI.

Affiliation

University of Prince Edward Island

Presentation type

Oral

Assessing environmental trade-offs of manmade waterbodies

Tonya DelSontro[1], Nandita Basu[1], Yves Prairie[2], Paul del Giorgio[2], Raisa Islam[1], Shayna Meinzinger[1]

[1]university of waterloo, [2]University of Quebec at Montreal

Several societal efforts to solve environmental issues involve creating waterbodies, such as reservoirs, ponds, or wetlands. While these measures seek to solve one environmental problem, they often create or contribute to another. In the case of reservoirs built for hydropower or flood protection purposes, or small ponds or wetlands created to improve downstream water quality, one major trade-off is the release of greenhouse gas emissions that subsequently contribute to climate change. Here, we present details in assessing the environmental trade-offs for reservoirs and restored wetlands in Canada. We identify the issue the proposed measures seek to address, relevant details of the measures taken, the potential environmental trade-offs with a focus on greenhouse gas and carbon emissions, and approaches to assessing those emissions. Finally, we discuss our ability to effectively evaluate the balance between these environmental trade-offs and what policies may exist to do so already.

Affiliation

University of Waterloo

Presentation type

Oral

An Aquatic Species at Risk Threat Assessment and Prioritization Exercise for the Lower Thames Valley Conservation Authority Watershed

Vicki L. McKay[1], Sarah E. Walton-Rabideau[1], Neil Pothier[1]

[1]Lower Thames Valley Conservation Authority

The Lower Thames Valley Conservation Authority undertook a two-year aquatic species at risk (SAR) threat assessment to better understand how a suite of environmental factors and stressors may impact 18 fish and 15 mussel SAR inhabiting the region's 58 subwatersheds and their critical habitats. Threats reviewed revolved around biology, soils, ecosystem modifications, climate change, water quality, drainage and connectivity, groundwater, urban development and water quantity. Threat information was assessed, using four different approaches, to rank 41 subwatersheds containing, or upstream of, one or more SAR. Threats selected for the prioritization exercise could be physically managed or mitigated through stewardship activities. These included soil erosion rates, turbidity levels, percent riparian shading, proportion of water quality samples exceeding provincial guidelines, calculated risk of water contamination and benthic indices. Eleven subwatersheds were identified as priorities for restoration and mitigation actions based on data availability. Those ranked based on sheer size indicated restoration efforts were needed in the western end of the watershed, while prioritization based on a per hectare basis shifted the focus to subwatersheds in the east. Focussing restoration efforts on these 11 priority subwatersheds allows the LTVCA to direct limited SAR funding to targeted projects in areas most likely to benefit aquatic SAR recovery.

Affiliation

Lower Thames Valley Conservation Authority

Presentation type

Oral

Environmental and genetic basis of intergenerational transcriptional plasticity in Brook charr (Salvelinus fontinalis)

Ghizlane BANOUSSE[1], Christina Semeniuk[2], Louis Bernatchez[3], Céline Audet[1]

[1]UQAR-ISMER, [2]Windsor University, [3]Université Laval

Variation in transcriptomic expression is commonly recognized as the underlying mechanism driving phenotypically plastic responses to environmental stress. Whether this variation is adaptive or maladaptive can have important consequences for the evolutionary trajectory of populations. However, little is known about the inheritance of this transcriptional variation between generations, whether it is genetic, non-genetic (such as environmental influences), or a combination of both factors. To address this knowledge gap, we assessed transcriptomic expression of targeted genes in Brook charr fry (*Salvelinus fontinalis*) reared at two different temperatures (5°C and 8°C), and issued from 37 families where both dams and sires were exposed to two thermal regimes during final gonad maturation, differing by 2°C. We used a high-throughput, OpenArray® chip to measure the relative expression of 24 candidate genes associated with biomarkers of environmental stress. Our findings revealed a downregulation in genes related to neurogenesis (NEUROD1, SOX2) and appetite regulation (CCK.L and NPY) in fry issued from the warm-parental group relative to the cold one. In contrast, only PCNA expression (a marker of DNA replication and repair) was found to be influenced by offspring-rearing temperatures, showing a downregulation in fry reared at 8°C relative to those reared at 5°C. Dam and sire effects will be analyzed to determine whether maternal or paternal effects are involved in these responses. Our results, in addition to validating the efficiency of a newly developed stress-response transcription profile array, will offer new insights into the quantitative genetic and environmental basis of transcription variation inheritance in Brook charr.

Affiliation

ISMER-UQAR

Presentation type

Oral

Wake Up - Impacts of Recreational Boat Wakes on Shoreline Habitat in the Rideau Canal Waterway

Steven Robinson[1], Jesse Vermaire[1], Colin Rennie[2], Steven Cooke[1]

[1]Carleton University, [2]University of Ottawa

Growth in pleasure craft ownership and the emerging popularity of wake-enhancing boats have raised concerns that freshwater and riparian ecosystems may be under increased stress from recreational boating. Boat wakes, the series of waves generated by a moving boat, can have variety of potentially harmful effects on shoreline environments, including shoreline erosion, increased turbidity, habitat disturbance, and impacts to biological communities. The relative impact of boat wake energy is most pronounced in low-fetch environments where wind wave energy is limited, such as rivers and canals. We present preliminary results of a boat wake impact study conducted on the Rideau Canal Waterway (RCW), one of Canada's most popular destinations for recreational boating. The study has two components: 1) a boat traffic survey to quantify the types and abundance of recreational boats in use on the RCW; and 2) experimental trials with different types of boats run at known speeds and distances from shore. In both study components, near-shore wave fields and turbidity were measured by RBR*maestro*[3] multi-channel logger to correlate boat wakes to sediment resuspension (a proxy indicator of erosion). Wakes were characterized by peak and significant wave heights and analyzed via continuous wavelet transforms. Sediment resuspension was inferred from turbidity data and correlated to boat wakes by time series analysis. The results will contribute to developing predictive models of shoreline impacts based on boat type, speed, and distance from shore that can be used to inform management action on the RCW and other Canadian waterways.

Affiliation

Carleton University

Presentation type

Poster

Salinity and the Atlantic Whitefish: Osmoregulatory and Stress Physiology of an Endangered Coregonid

Zaina Lamontagne[1], Annie Grigg[1], John Batt[2], Jeremy Broome[3, 4], Paul Bentzen[1], Anne Dalziel[5], Emily Yeung[1]

[1]Department of Biology, Dalhousie University, [2]Aquatron Laboratory, Dalhousie University, [3]Bedford Insitute of Oceanography, [4]Fisheries and Oceans Canada, [5]Department of Biology, Saint Mary's University

The Atlantic Whitefish (*Coregonus huntsmani*) is an endangered, anadromous fish endemic to Nova Scotia, Canada, where it is historically known in two locations: The Tusket Annis River and Petite Rivière watersheds. Today, only the Petite Rivière (PR) population remains, where it has been effectively isolated from the sea for a century and has continued to decline. In 2006, Fisheries and Oceans Canada proposed a three-part recovery strategy for the species to: (1) achieve stability in the current population, (2) expand the species range, and (3) re-establish anadromy. None of these goals have been achieved to date. Restoring anadromy for the Atlantic Whitefish could provide substantial benefits to the population such as increased habitat and food availability. However, isolation from marine environments may mean anadromy is no longer a viable life-history strategy for the species. For re-establishment of anadromy to be successful, we must understand how whitefish from the Petite Rivière respond to conditions they may encounter during journeys to and from nearshore marine habitats, including changing salinity and temperature regimes. The overarching goal of this study is to assess the effects of salinity, temperature, and their interaction on the growth, osmoregulatory capacity and stress response of Atlantic Whitefish from the PR. I will do this by comparing relative growth and blood parameters (plasma Na+, K+, Cl-; lactate, glucose, cortisol, haematocrit, blood cell differential) across treatment groups of juvenile Atlantic Whitefish acclimated to different salinities under a change in water temperature.

Affiliation

Department of Biology, Dalhousie University

Presentation type

Oral

Evaluating the use of early warning signals to predict a warming-induced experimental epidemic

Martin Krkosek[1], Peter Molnar[1], Madeline Jarvis-Cross[1]

[1]University of Toronto

While it's clear that climate change can facilitate novel species interactions, enabling disease emergence and resulting in epidemic emergence, our ability to predict epidemic emergences is limited. Here, we build off Kirk et al. (2020) by using experimental data to explore how the theory of early warning signals (EWS) may be used to predict warming-induced epidemics in a *daphnia*-microsporidian system. Theory suggests that when a system approaches a critical transition, it will exhibit statistically anomalous behaviours individually termed "early warning signals", and collectively termed "critical slowing down". Mathematically, critical slowing down occurs as a system approaches a bifurcation point and becomes increasingly slow to recover from small perturbations. In the context of infectious disease systems, early warning signals may precede and thus be used to predict the bifurcation point that leads to disease emergence.

While early warning signals have been identified from epidemic data, emerging methods, including the pre-processing raw data by detrending with a Gaussian kernel, may help distinguish a signal from noise and periodic trends, resulting in fewer false positives. Further, while critical slowing down precedes several bifurcation types, only recently have methods been developed to (1) identify early warning signals as specific to a given bifurcation type, and thus, (2) anticipate bifurcation type and the quality of the forthcoming state. We intend to apply these methods to Kirk et al.'s (2020) experimental epidemic data to (1) compare methods of epidemic prediction, and (2) determine if bifurcation types can be identified from experimental epidemic data.

Affiliation

University of Toronto

Presentation type

Oral

A large-scale paleolimnological study of a fluvial lake on the St. Lawrence River: trends in hydrology, eutrophication, and climate-change impacts

Katherine Moir[1], Isaac Armstrong[1], Cale Gushulak[2], Peter Leavitt[2], Jeffrey Ridal[3], Brian Cumming[1]

[1]Queen's University, [2]University of Regina, [3]St. Lawrence River Institute of Environmental Sciences

Lake St. Francis (LSF) is a fluvial lake on the St. Lawrence River, located approximately 200 km downstream of the outlet of Lake Ontario, just upstream of Montreal. This region has been subjected to numerous local and regional anthropogenic stressors over the past century, including major hydrological modifications, high loads of organic and inorganic pollutants from upstream industries, elevated nutrient concentrations from highly agricultural watersheds, and ongoing climate-change impacts. Although the effects of many of these stressors have been reduced in recent decades, evidence suggests that communities of algae may be shifting towards an increasing prevalence of cyanobacteria, a trend that has been reported in some lakes in recent years. A large-scale paleolimnological study was undertaken to assess whether this pattern is occurring across the breadth of LSF, and how recent climate-change impacts might be separated from the effects of legacy stressors in the sediment record. Eight sediment cores were collected from five different sedimentation basins in LSF, covering a time span ranging from several decades to over a century. Analyses of subfossil diatom (Bacillariophyceae) assemblage structure, sedimentary photosynthetic pigment concentrations, and sediment geochemistry ($\delta^{13}C$, $\delta^{15}N$, C:N, loss-on-ignition) highlight several recent and historical changes in LSF. The timing of these shifts with respect to known local impacts (e.g., dam construction) and previously reported climate-change impacts on freshwater systems will be discussed.

Affiliation

Queen's University

Presentation type

Oral

The cumulative Expected Toxicant Load in New Brunswick rivers from historical pesticide applications

Christopher Edge[1], Scott Sugden[2], Moira Ijzerman[3], Jessica Ollinik[4], Ilya Dimitrovas[5], Sandra Emry[6], Xiaotian Hua[2], Josh Kurek[5], Jennifer Lento[7], Katelyn Morrow[5], Laura Schnell[4], Markus Thormeyer[6], Amy White[8], Karen Kidd[9]

[1]Canadian Forest Service, [2]McGill University, [3]University of Guelph, [4]University of Regina, [5]Mount Allison University, [6]University of British Columbia, [7]University of New Brunswick, [8]University of Waterloo, [9]McMaster University

Pesticides use in forestry and agriculture began in the 1920s and began to rise dramatically in the 1950s with the advent of non-selective insecticides, airplanes, and methods to apply via foliar applications. A well-known example are the large-scale aerial spray programs (1952-1993) in New Brunswick, Canada, during which 12 insecticides were applied to forests resulting in 97 % of 6.2 million ha of the forested lands being treated with at least one application of one insecticide. Some of the pesticides used historically were efficacious, non-selective, persistent, and le d to serious impacts on the aquatic environment when they were applied. The most well known insecticide was dichlorodiphenyltrichloroethane (DDT), applied from 1952-1968. The insecticides that replaced DDT were non-persistent and unlikely to be found today. Together, the cumulative application of these insecticides likely led to impacts on the aquatic environment. As a first step to investigate potential impact we developed a metric, the Expected Toxicant Load (ETL), based on the relative toxicity of each insecticide to *Daphnia magna*. Using the ETL to estimate cumulative toxicity was supported by a relationship between historical applications of DDT and modern sediment concentrations and a literature review showing the relative toxicity of each pesticide to *D. magna* and benthic invertebrates is consistent. Here we present a history of pesticide application to New Brunswick Forests and demonstrate the utility of the ETL to predict toxicity to benthic invertebrates.

Affiliation

Canadian Forest Service

Presentation type

Oral

Hydrological and sediment modelling in the southern Gulf of St.Lawerence: A useful tool for the development of environmental guidelines in coastal areas.

André St-Hilaire[1], Aziz Essalhi[2], Michael Van Den Heuvel [3], Simon Courtenay[4]

[1]Professor at the INRS - Director, [2]PhD Student at the INRS, [3]Professor at the PEI University - Codirector, [4]Professor and Director, School of Environment, Resources and Sustainability University of Waterloo - Codirector

The present project focuses on the development of deterministic and statistical models to estimate the sediment load that is discharged into the estuaries of the southern Gulf of St. Lawrence. To achieve this, water level (Hobo sensors) and turbidity meters were deployed upstream of the tidal of six watersheds flowing into the southern Gulf of St. Lawrence. Data from Environment Canada Hydrometric stations located in the vicinity of the monitoring gauged stations was used for this project. Regarding the ungauged monitoring stations, flow measurement was taken during 2022 and 2023. Turbidity measurements were recorded by the turbidity meter. At each station, a calibration curve was developed to convert turbidity measurements (in mV) to Suspended Solids Concentration (SSC) in (mg/L). In this project, as a first step, the 'Soil and Water Assessment Tool (SWAT)' model was calibrated for flows and SSC against in situ observations. Partial results of this calibration indicated that the model is adequate to simulate discharge with KGE values ranging between 0.71 and 0.82. SSC calibration will soon be completed, and the model will be used to simulate historical discharge and SSC for the last 30 years. Additionally, the outcomes derived from the SWAT model will be evaluated against those generated by a statistical model known as the Adaptive Neuro-Fuzzy Inference System model. The outcome of this project will be used by the Department of Fisheries and Oceans Canada to promulgate environmental guidelines on sediment loads in estuaries and coastal environments in the southern Gulf of St. Lawrence.

Affiliation

Institut national de la recherche scientifique (INRS) - Université de Québec

Presentation type

Oral

Going Against the Flow: Small-Scale Hydrodynamics Influence Trap Entry by Sea Lamprey (Petromyzon marinus)

Deven Nicholson[1], Kaylin Jones[2], Aline Cotel[2], Scott Miehls[3], Dan Zielinski[4], Rob McLaughlin[1]

[1]University of Guelph, [2]University of Michigan , [3]U.S. Geological Survey, [4]Great Lakes Fishery Commission

Scientists are being asked to develop methods of controlling or eliminating invasive species and their unwanted effects. Trapping is one method being explored. We examined experimentally if small-scale hydrodynamics at the opening into traps influenced rates of trap entry by Sea Lamprey (*Petromyzon marinus*), an invasive species in the Great Lakes and the target of a basin-wide control program. Entry rates into traps need to improve before trapping can become a viable method of control. Our experiments tracked the search and entry behaviour of Sea Lamprey released in flumes where trap design (funnel opening placed in a mesh versus solid wall) and discharge through the funnel opening (low versus high) were manipulated across nights to elicit changes in hydrodynamics at the trap entrance. We expected a funnel opening in a mesh wall would be harder to find, but easier to pass through, while a funnel in a solid wall would be easier to find, but harder to pass through. Hydrodynamics in front of the funnel entrance differed between treatment groups. Overall, Sea Lamprey were twice as likely to enter a funnel in a mesh trap under high funnel discharge, than a mesh trap under low discharge, or a solid trap under low or high discharge. Time spent searching for the funnel opening similarly varied with trap design and discharge. Our findings will benefit the Sea Lamprey control program by helping resource managers identify trap designs that could provide the trapping efficiency needed for control purposes.

Affiliation

University of Guelph

Presentation type

Oral

Development and standardization of stressor-response functions for cumulative effects modelling

Jordan Rosenfeld[1], Lauren Jarvis[2], Matthew Bayly[3, 4], Alex Tekatch[4], Eva Enders[5]

[1]B.C. Minstry of Water, Land, and Resource Management, [2]DFO, [3]Bayly Analytics, [4]ESSA, [5]INRS

Cumulative effects models in natural resource management are intended to provide a framework for assessing the effects of multiple stressors on populations, communities, or ecosystems, usually with the goal of prioritizing activities to reduce stressor levels. Optimizing resource allocation among competing stressors requires a quantitative understanding of how stressor magnitude affects the ecological response, which will differ among stressors and is typically represented by stressor-response functions. Stressor-response functions are therefore a core element of any cumulative effects model since they drive all stressor impacts and model predictions. Consequently, defining the form, uncertainty, and underlying properties of stressor-response functions (e.g., linearity vs. non-linearity, slope, intercept) is a critical step in cumulative effects modelling. Standardizing stressor-response functions may increase their transferability across populations and ecosystems, can be a powerful may of identifying underlying mechanisms, and may be a requirement for some cumulative effects models. We use examples from the realm of aquatic ecology to illustrate the key properties of stressor-response functions and how to derive and standardize them.

Affiliation

B.C. Ministry of Water, Land, and Resource Stewardship

Presentation type

Oral

Distinct gene expression differences in Atlantic salmon among wild Newfoundland and farmed European and North American populations and their hybrids at hatching and emergence.

Eric Ignatz[1], Shahinur Islam[2], Xi Xue[1], Albert Caballero-Solares[1], Jennifer Hall[1], Ian Bradbury[3], Rise Matt[1], Ian Fleming[1]

[1]Memorial University of Newfoundland, [2]University of Windsor, [3]Fisheries & Oceans Canada

Escape of genetically distinct farmed Atlantic salmon raises concerns about their potential interaction with wild populations and disruption of local adaptation through genetic admixture. It is often unknown whether genetic origin or common domestication effects will have a greater influence on consequences posed by escaped farmed fish. We showed previously that domestication can have prevalent effects on behaviour and growth of farm salmon, independent of their genetic origin. Yet, we have little understanding of whether this extends more broadly to gene expression, particularly at critical early life stages. We thus quantified gene transcript expression differences among divergent farmed (North American [NA] and European [EO]), wild (Nfld) and F1 hybrids at (1) hatching and (2) emergence under controlled conditions using 44 K microarrays and subsequent qPCR analysis. Our findings indicate that the wild population showed greater transcriptome differences relative to the EO- than the NA-farmed strain at both life stages, and that the largest differences existed between the two farmed strains themselves. The fewest differentially expressed transcripts existed between F1 hybrids and domesticated/wild maternal strains. Of the differentially expressed genes among cross types, over-represented GO terms were associated with metabolism, development, growth, immune response, and redox homeostasis processes. Interestingly, despite similarities in the overall extent of gene expression differences among cross types at the two life stages, several of the patterns differed. Overall, our findings suggest that interbreeding of escaped farmed with Nfld-wild populations would alter gene transcript levels, and the consequences would be greater from escaped EO- than NA-farmed salmon.

Affiliation

Memorial University of Newfoundland

Presentation type

Oral

ASSESSING THE IMPACT OF LAND USE ON ZOOPLANKTON COMMUNITIES IN A LARGE RIVER FLOODPLAIN: AN INTEGRATIVE APPROACH

Shahin Badesab[1], Vincent Fugere[1], Gilbert Cabana[1], Geneviève Berger[1], Corentin Flinois[1], Assetou Sacko[1], Laiza De Carvalho Lima[1], Andrea Bertolo[1]

[1]UQTR

Floodplains support productive zooplankton communities, which form dormant stages as flood waters recede. Dormant stages/propagules stored in floodplain soils help rebuild water-column populations at the onset of the next flooding cycle. However, agricultural expansion and intensification on floodplains may impact these propagule banks, in addition to direct effects on adult stages via declines in water quality. Through experimental and field observations, we addressed the impact of agricultural intensification on floodplain zooplankton by characterizing communities during spring flooding, hatching resting stages in the laboratory and tracking the performance of *Daphnia magna* cultures exposed to floodplain soils. We compared natural wetlands and agroecosystems in four regions of the largest floodplain along the St-Lawrence River. We hypothesized that 1) zooplankton abundance and diversity would be higher in natural wetlands than in flooded agricultural soils; 2) propagule density would be higher in natural than in agricultural soils; 3) pesticides in agricultural soils would impair the survival, reproduction, swimming, and physiology of zooplankton. We found that, as predicted, land use impacted zooplankton communities during flooding. Similarly, in a lab experiment, more zooplankton hatched from natural than agricultural soils, but there was a poor match between water-column communities and those hatched in the lab. Lastly, the soil leachates showed no strong impact on *D. magna* performance. Together, these results indicate that agricultural intensification can alter floodplain zooplankton communities and their dormant stages stored in soils, yet the causal mechanisms at play in our study system remain unclear.

Affiliation

University du Quebec a Trois-Rivieres

Presentation type

Oral

Integrating remote underwater video and electronic tagging data: a decade of parallel research programs converge

Electronic tagging inputs to marine fisheries assessments and non-extractive video surveys designed initially to understand patterns and dynamics of marine biodiversity are often considered separately, and by different research groups. However, over the past decade, our collaborative research programs involving analyses of >190 pop-up satellite archival tags (PSATs) to understand habitat use, spawning behaviours, and spatial distributions of Atlantic halibut (*Hippoglossus hippoglossus*) over annual cycles and the deployment of baited remote underwater video (BRUV) landers at >75 locations in the Northwest Atlantic and Canadian Arctic to capture diversity and abundance data have led to convergence in the application of these methods to address complimentary research goals. BRUV surveys within offshore marine refuges can serve as reconnaissance informing tagging operations and the expanding spatial distribution of Atlantic halibut that currently supports Canada's most lucrative demersal finfish fisheries. PSAT geolocation data from Atlantic halibut can be used to quantify the temporally dynamic biodiversity conservation benefits of marine reserves. While integrating these approaches provides data on complimentary spatial and temporal scales, there are inherent disconnects in scales and important potential biases and uncertainties that should be considered when interpreting and linking these methods. This presentation will outline the history of these programs, identify how biases and uncertainties have been considered, and provide suggestions for others similarly linking technologies given the rapid expansion and applications of both electronic tagging data programs and underwater imagery collections.

Affiliation

Memorial University of Newfoundland

Presentation type

Oral

Mussels in peril: understanding human-induced threats to freshwater mussels in New Brunswick

Kerstyn Dobbs[1, 2], Tyler Lynn [1, 2], Aruna Jayawardane[3], Meghann Bruce[1, 2], Michael Duffy[1, 2]

[1]University of New Brunswick, [2]Canadian Rivers Institute , [3]MALISEET NATION CONSERVATION COUNCIL

Freshwater mussels (Bivalvia, Unionida) are ecosystem engineers, playing essential roles in freshwater ecosystems, however, they are among the most imperilled organisms in North America due to many influences including anthropogenic interventions. Freshwater mussels rely on host fishes to complete metamorphosis from larvae (glochidia) to juveniles, so any river regulation impairing fish passage can prevent natural mussel translocation and their ability to survive. The Petitcodiac River watershed in New Brunswick (NB) was regulated by a causeway without fish passage mechanisms from 1968-2023. The Dwarf Wedgemussel (*Alasmidonta heterodon*) is presumed extirpated from the Petitcodiac River (the only population in Canada) due to this causeway and the impaired passage of host fishes. The removal of the causeway is concurrent with initiatives by the Fundy Salmon Recovery Program which is working to increase Atlantic salmon (*Salmo salar*) populations which indirectly benefits mussels. Baseline data shows 31% infestation of Salmon parr by Eastern Pearlshell (*Margaritifera margaritifera*) glochidia suggesting this mussel relies on Salmon and perhaps other salmonids. The Mactaquac Generating Station in the Wolastoq | Saint John River (W|SJR; NB) is one of five dams in the river but it is the largest, furthest downstream, and has intentional upstream fish passage limited to three anadromous fishes. The Yellow Lampmussel (*Lampsilis cariosa*), a species of Special Concern, is only found in the lower W|SJR watershed in NB since the lack of fish passage may have halted upstream dispersal. Invasive Zebra Mussels (*Dreissena polymorpha*) have recently been introduced to the W|SJR, posing another threat to Yellow Lampmussel survival.

Affiliation

University of New Brunswick

Presentation type

Oral

Salmon River Watershed Initiative

With the aim to restore a healthy Salmon River watershed in what is now known as the South Interior of British Columbia, this Splatsin te Secwepemc lead initiative is focused on understanding values, current conditions and priority concerns related to the health of the Salmon River watershed. This initiative builds on the previous efforts of the Salmon River Watershed Roundtable, which formed in 1993 and was responsible for over 470 restoration projects with over 100 landowners, to support the recovery of wild salmon populations and enhance the ecological function of the watershed through the application of indigenous knowledge systems, science-based data, and a holistic approach to caretake water flows for a healthy watershed.

Indigenous knowledge systems and climate change have generally not been considered in water planning and land development decisions in the Salmon River watershed. By establishing and holding ethical space for Secwepemc knowledge systems, this project builds upon new and established relationships between the water, the land, government agencies, land users and rights holders, and promotes informed decision making through developed understanding of values, current conditions and concerns as well as opportunities for restoration to recover ecosystem function and freshwater security within the Salmon River watershed.

Affiliation

Splatsin te Secwepemc

Presentation type

Oral

Environmental change in Yellowknife Bay, Northwest Territories, over the last two centuries inferred through diatom paleolimnological analysis.

David Lapins[1], Kathleen Rhuland[2], John Chetelat[3], John Smol[2], Jesse Vermaire[1]

[1]Carleton University, [2]Paleoecological Environmental Assessment and Research Lab, Queen's University, [3]Environment and Climate Change Canada

Great Slave Lake, Northwest Territories, is one of the largest subarctic lakes in the world and the deepest lake in Canada. The duration and strength of thermal stratification is increasing in many subarctic lakes across the northern hemisphere, including Great Slave Lake where recent dramatic changes in the diatom community have been observed in the open-water portion of the lake. This research uses paleolimnological techniques to investigate ecological changes occurring in the more enclosed Yellowknife Bay, Great Slave Lake, over approximately the last two centuries based on the analysis of diatoms, sedimentary Chl*a*, and metals of a dated sediment core. The results of this thesis showed a sharp increase in the relative abundance of the smaller planktonic *Discostella stelligera* from <10% to ~25% diatoms and a decline in heavier *Aulacoseira* sp. These data suggest that in recent decades thermal stratification is increasing in Yellowknife Bay with potentially important ecological consequences for this large subarctic lake.

Affiliation

Carleton University

Presentation type

Oral

Investigating pre- and post-industrial presence of Atlantic Salmon in the Wolastoq Watershed

Victoria Cluney[1], Gordon Grey[1], Jason Hall[1], Ave Dersch[2]

[1]Wolastoqey Nation in New Brunswick, [2]Moccasin Flower Consulting

The colonial influence in Wolastoqey territory spans almost 300 years. As such, it is difficult to assess the cumulative effects industrialization has had on Wolastoqey land and resources, culture, and livelihood. Establishing a pre-industrial baseline for cultural keystone species is a starting point to begin to understand the cumulative impact colonization and industrialization have had on the Wolastoq and its people. This study aimed to use multiple lines of evidence to co-produce knowledge about the presence of Atlantic Salmon (*Salmo salar*) in the Wolastoq watershed. Historic and ethnohistoric documents, Wolastoqey Indigenous knowledge, and Western science data in the form of environmental DNA were braided together to characterize both pre-industrial and current presence of this critically important, but now threatened species. Comparing information gathered via Indigenous Knowledge interviews and ethnohistoric data with current aquatic environmental DNA samples has provided insight to how industrial practices, for example, hydroelectric dams, have influenced the existence of Atlantic salmon in the Wolastoq, and the cultural consequences its decline has had on the Wolastoqey Nation, and their inherent Rights. This study was conducted by technical staff at the Wolastoqey Nation in New Brunswick (WNNB), a not-for-profit organization that represents the six Wolastoqey communities. WNNB coordinates and provides technical advice to community members regarding matters that relate to their constitutionally protected Aboriginal and Treaty Rights.

Affiliation

Wolastoqey Nation in New Brunswick

Presentation type

Oral

Investigating parasitic castration of host fishes by the cestode Ligula intestinalis and development of non-lethal diagnostics

Shawn MacLellan[1], Megan Fraser[1], Michael Duffy[1]

[1]University of New Brunswick

Ligula intestinalis, a tapeworm that infects freshwater fishes during its plerocercoid (i.e., larval) life stage, was recently identified in New Brunswick for the first time. Species level identifications were made using morphological characteristics and by sequencing COX1 mitochondrial DNA. Plerocercoids of *L. intestinalis* occupy the peritoneal cavity of their fish host and promote consumption by a piscivorous bird, where the parasites mature in the intestine. Adult parasites pass eggs to the water column with feces of the bird host, where they hatch and are eaten by copepods. Preliminary surveys have been utilized to identify copepod species that are susceptible to infection and to determine prevalence. Fish become infected by eating infected copepods. Heavily infected fish are easily identified by the severe abdominal distention caused by the parasite, however newly infected fish are not easily identifiable. Non-lethal DNA diagnostic methods are currently under development for the identification of infected fishes.

Plerocercoids of *L. intestinalis* induce sterility of their host fishes, however the mechanisms are poorly understood. We are developing an *in vitro* culture system to complete the parasite's life cycle and acquire eggs. Eggs will be used for experimental infections in lab-reared zebrafish to investigate this parasitic castration effect. Additionally, *in vitro* culture systems are being employed to collect plerocercoid secretions for the identification of compounds which may have endocrine disrupting effects. Such compounds represent novel biologicals that could be used in commercial aquaculture to disrupt gonad development, divert resources to muscle production, and decrease time to market for farm-raised fish.

Affiliation

University of New Brunswick Fredericton

Presentation type

Oral

Daphnids abundance, dissolved organic carbon and Magnesium: key factors shaping Holopedium spp abundance in US lakes

Corentin Flinois[1], François Guillemette[1], Andrea Bertolo[1]

[1]UQTR

Holopedium spp are zooplanktonic organisms forming a gelatinous capsule to protect itself from predators. If abundant, these capsules, made up of complex sugars and therefore rich in carbon, might eventually play an important role in the carbon cycle of Northern Hemisphere lakes. This might be the case in those lakes where the hydrogen potential of the water has plummeted following episodes of acid rain since the 1950s, where these cladocerans proliferate supposedly because of a drop in their main competitor (i.e. *Daphnia*). Though, there is a lack of large scale studies checking the main biotic and abiotic factors driving *Holopedium* abundance. Our aim is to assess the variation in absolute abundance of *Holopedium* in temperate lakes at the scale of the United States of America (2007 National Lake Assessment data, collected by the Environmental Protection Agency), and to present our preliminary analyses about the spatial (i.e. ecoregion), biotic (e.g. competitors), physicochemical factors (e.g. pH and DOC) potentially influencing it. We conducted multivariate analyses to measure the relationship between these variables and *Holopedium* abundance. In line with the literature, the abundance of *Holopedium* increases when that of daphnids, its main competitors, decreases. However, we observed that, instead of pH, the main factor apparently driving *Holopedium* abundance in these lakes is, unexpectedly, the concentration of magnesium. Another factor linked to *Holopedium* abundance is the concentration of dissolved carbon, which might eventually be used by *Holopedium* to synthesize its gelatin capsule. The potential mecanisms behind these patterns are discussed.

Affiliation

UQTR

Presentation type

Oral

Advancing river temperature Modeling in ungauged Atlantic salmon rivers: A hybrid regional approach

Ilias hani[1], André St-Hilaire[1], Taha B.M.J Ouarda[1]

[1]INRS

With the overarching goal of adapting a water temperature model for simulations in ungauged rivers, this study explores the regionalization of thermal parameters within a deterministic semi-distributed hydrological model (CEQUEAU). The research focuses on 33 unregulated Atlantic salmon rivers across northeastern Canada and the USA. The methodology incorporates a sensitivity analysis (SA) of the model's thermal parameters to pinpoint influential factors. The SA utilizes a technique known as variogram response surface analysis (VARS), providing sensitivity measures based on both derivatives and variance. Furthermore, this study compares various techniques for selecting explanatory (physio-climatic) variables to establish links between watershed characteristics and CEQUEAU thermal parameters. A parallel strand of the study contrasts the regionalization approach of the CEQUEAU model's parameters with a statistical method. This method integrates regression among diverse watershed characteristics and a signature of the thermal regime—temperature duration curve (TDC)—alongside a spatial interpolation method. The validation of these methods is performed using a leave-one-out cross-validation approach. The most successful method identified through validation will be employed to estimate water temperature at ungauged sites. Subsequently, this will facilitate the generation of a synthetic river temperature time series for ungauged rivers, enhancing available information on water temperature in Atlantic salmon rivers and providing invaluable insights for environmental monitoring and management.

Affiliation

INRS

Presentation type

Oral

Advancing Indigenous Knowledge and Wisdom in the Great Lakes Basin

Place holder to be edited

Affiliation

International Association for Great Lakes Research

Presentation type

Oral

Insights into Migration Success of Alewife Through a Hydro-Facility using Complementing Technologies

Upstream and downstream migration of Alewife (*Alosa pseudoharengus*) was evaluated through a pool and weir fishway and two downstream bypasses at the White Rock Hydroelectric Facility (Nova Scotia Power Inc.), on the Gaspereau River, Nova Scotia, Canada using a recently developed miniaturized ultrasonic transmitter and a next generation Tagless Fish Tracking system. Both were developed as part of the OceanAware project funded by Canada's Ocean Supercluster and in May 2022, 250 Alewife were externally tagged with the transmitters to evaluate their passage success and migration. During the migration, tagged Alewife were monitored both by acoustic receivers, and by the Tagless Fish Tracking system that employed real-time video and artificial intelligence (AI) techniques to produce real-time fish counts at the upstream fish ladder exit.

From April to June 2022, the Tagless AI system counted 918,169 Alewife, which was verified by human counts to within 95%. The addition of the acoustic monitoring system provided valuable data on route choice, survival, and passage efficiency. Acoustic receivers placed in the turbulent fish ladder and bypass channel detected tagged fish with 100% efficiency. Alewife migrated to different destinations in the river system, suggesting several spawning locations, with 64% of migrating fish returning to the facility and 50% returning to the estuary. Passage efficiency through the power turbines and surface bypasses was 95%. The results from both the ultrasonic tagging system and the Tagless AI system showed strong diurnal patterns in the upstream and downstream migration with the upstream migration exhibiting the strongest diel signal.

Affiliation

Innovasea

Presentation type

Oral

Conservation successes from the application of a watershed connectivity restoration planning process

Nicolas Lapointe[1], Nick Mazany-Wright[1], Fielding Montgomery[1], Craig Mount[2], Simon Norris[3], Betty Rebellato[1]

[1]Canadian Wildlife Federation, [2]British Columbia Ministry of Water, Land and Resource Stewardship, [3]Hillcrest Geographics

Aquatic barriers to fish movement are prevalent across much of Canada and affect fish production and population viability. Given the number of barriers and costs of connectivity restoration, prioritization methods are needed to help address this conservation issue efficiently. A watershed connectivity restoration planning framework based on the international Conservation Standards is being implemented in eight watersheds across Canada. This planning framework involves engaging local partners to define a geographic scope, select focal fish species, estimate the current habitat connectivity status, define concrete goals for gains in connectivity, and prioritize barriers to achieve those goals. Novel spatial models identify habitats that would be accessible to focal species in the absence of anthropogenic barriers and the subset that are suitable for spawning, rearing, or refuge. A connectivity model overlays barriers to estimate how much suitable habitat is connected, and which barriers contribute the most to fragmentation. Model outputs are used to estimate connectivity status and prioritize field assessments, focusing on potential barriers with the most suitable habitat upstream. Based on field results, barriers are confirmed or removed from the model if they are passable or if upstream habitat is unsuitable. Uncertainly regarding connectivity status is reduced rapidly by iteratively focusing on sites with the most habitat upstream. In the Horsefly River Watershed in BC, this process reduced consideration of thousands of potential barriers in a watershed to 17 that blocked 43% of disconnected Pacific Salmon habitat. Efforts to address these priority barriers are progressing rapidly and two have been removed.

Affiliation

Canadian Wildlife Federation

Presentation type

Oral

Genomic diversity of Fundulus diaphanus in Atlantic Canada

Katherine Haché[1], Paul Bentzen[1], Steven Duffy[2], Nicole Smith[2], Philip Sargent[2], Ian Bradbury[2]

[1]Dalhousie University, [2]Fisheries and Oceans Canada

Anthropogenic impacts on freshwater ecosystems are driving rapid habitat deterioration and population decline, outpacing impacts in other environments, and resulting in a biodiversity crisis. Insufficient intraspecific genetic diversity, on which selection can act, limits adaptative potential and can increase the likelihood of extinction. One such freshwater species, the Banded Killifish (*Fundulus diaphanus*), found in Atlantic Canada and elsewhere across eastern North America has been assessed as a species of Special Concern by COSEWIC. Currently, the Newfoundland population is defined as a Designatable Unit (DU) due to its location in a different biogeographic zone and on the periphery of the species range (thus, subject to distinct selective pressures), and the isolation of Newfoundland. To date, little research has been conducted on intraspecific variation of *F. diaphanus* populations to assess evolutionary significance of any Canadian populations. To address this knowledge gap, we generated a chromosome-scale reference genome assembly, and conducted whole genome resequencing on *Fundulus* individuals from sites across Newfoundland, Nova Scotia, and New Brunswick. Our objectives are to (1) investigate genomic diversity across the species' Atlantic Canadian distribution, (2) explore the frequency of hybridization of *F. diaphanus* and *Fundulus heteroclitus,* and (3) to quantify the number and diversity of clonal lineages of hybrids present. This work will directly inform, the conservation of this species including the identification of DUs in Canada moving forward.

Affiliation

Dalhousie University

Presentation type

Poster

Genomics-based mixed-stock analysis reveals potential unsampled populations and population differences in intra-lake migration in walleye

Julie Gibelli[1], Hari Won[1], Sozos Michaelides[1], Hyung-Bae Jeon[1], Pamela Macleod[2], Hubert Petawabano[2], Dylan Fraser[1]

[1]Department of Biology, Concordia University, 7141 Sherbrooke St. West, Montreal, QC, H4B 1R6, Canada, [2]Cree Nation Of Mistissini, 187 Main St, Mistissini, Quebec G0W 1C0

Stock contributions to annual harvests provide key insights to conservation, especially in fish species that return to specific spawning sites and may establish genetically distinct populations. In this context, genetic stock identification (GSI) requires reference samples, yet sampling might be challenging as spawning sites could be in remote and/or unknown areas. Thus, any potential missing source population needs to be accounted for in management recommendations. Here, we (i) genotyped 1487 walleye (*Sander vitreus*) samples using a GT-seq panel of 336 single nucleotide polymorphisms and (ii) assessed individual migration distances from GPS records of fish harvested in two neighboring northern Quebec lakes (Mistassini and Mistasiniishish) important to the local Cree community. Samples were assigned to a source population using two methods, one requiring allele frequencies of known populations (RUBIAS) and the other without prior knowledge (STRUCTURE). Individual assignments to a known population reached 96% consistency between both methods. All five major source populations were identified in Mistassini Lake, but there was evidence of up to three small unsampled populations. Furthermore, Mistassini walleye populations were characterized by large differences in average migration distance, with some remaining near their spawning rivers. In contrast, walleye in Mistasiniishish Lake were assigned with very high confidence to two populations with similar distribution throughout the lake. The complex population structure and migration patterns in the larger Mistassini Lake suggest a more heterogeneous habitat and thus, greater potential for local adaptation. This study highlights the importance of combining analytical approaches to improve GSI studies for conservation practices.

Affiliation

Concordia University

Presentation type

Oral

Changes in the spatial complexity of submerged aquatic vegetation along environmental gradients in a fluvial lake

Arthur de Grandpré[1, 2], Christophe Kinnard[1, 3], Andrea Bertolo[1, 2]

[1]Université du Québec à Trois-Rivières, [2]Interuniversity research group in Limnology (GRIL), [3]Centre d'Études Nordiques (CEN)

The growing availability of high-resolution aerial imagery brings a multitude of new opportunities for the monitoring of aquatic ecosystems. Among them, the use of very-high resolution multispectral imagery to map submerged aquatic vegetation (SAV) brings us closer than ever to the operationalization of a biomonitoring index based on habitat complexity and resilience. Because of the feedback loops between their roles as ecological engineer and ecological indicator, SAV species are strong candidates to generate early warning signals of ecological transitions through their spatial complexity (i.e. landscape organization). In this study, we evaluate indicators of spatial complexity in SAV landscapes across environmental gradients located in a fluvial lake. By using an open-source object-oriented image classification pipeline, high-resolution SAV maps were produced, and their spatial complexity was analyzed along gradients of multiple stressors, including depth, light availability, flow speed, nutrient availability and anthropogenic impacts. Preliminary results suggest a co-occurrence of multiple stressors, highly colinear with depth and the contribution of different masses. Despite confounding factors, a clear empirical link between environmental variables and SAV spatial complexity is exposed, suggesting a strong potential for SAV as a broad-spectrum ecological indicator. We therefore advocate for a better, systematic monitoring of SAV landscapes in key ecosystems, and the construction of spatio-temporal SAV distribution databases to allow a deeper understanding of their dynamics and of their roles as ecological sentinels.

Affiliation

UQTR

Presentation type

Poster

Development of an environmental flow research program in Quebec

Laureline Berthot[1], André St-Hilaire[1], Marie Larocque[2]

[1]Institut National de la Recherche Scientifique, [2]Université du Québec à Montréal

Faced with increasing demands for surface water and groundwater withdrawals, the Quebec Ministry of Environment wants to develop an environmental flow (e-flow) research program. Presently, the Quebec policy advocates that water abstraction be limited to 15% of a two-year minimum flow with a duration of seven days (7Q2) in the rivers.

Recently, e-flows studies based on flow time series, stream gauges, water temperature datasets, and climate change scenarios in southern Quebec were made. They confirmed that flow regulation must consider the regional variability of hydrology for the current climate and anticipate the future climate. Habitat proxies such as wetted perimeter can be useful, as well as the consideration of increase in water temperature to limit water withdrawals while protecting river ecosystems. However, groundwater is almost never considered in determining e-flows, and this strongly limits the scope of current regulations in integrated water management approaches.

Over the course of the next year, a research program will be elaborated to include themes such as connectivity, river ecology, aquatic fauna, river geomorphology, groundwater, and water management. The main objectives are to (1) identify users and document their needs ; (2) study the connection between surface water, groundwater, and ecosystems, to recommend e-flows oriented towards the good health of river ecosystems during low flow periods ; (3) develop methods to better spatialize e-flows and to study their transferability from the watershed scale to the river section ; and (4) list recommendations to rethink e-flows regulations.

Affiliation

Institut National de la Recherche Scientifique

Presentation type

Oral

Quantifying the dispersal of infectious agents and fish eDNA originating from salmon farms

Jaime Grimm[1], Martin Krkosek[1], Andrew Bateman[2], Kristina Miller[3], Ningxiner Wen[1], Shaorong Li[3], Robert Masaki Hechler[1]

[1]University of Toronto, [2]Pacific Salmon Foundation, [3]Fisheries and Oceans Canada

Open pen aquaculture facilities used for domestic salmon in coastal British Columbia create spatially static, high-density host populations allowing infectious agents to proliferate. These conditions allow sustained epidemic levels of transmission both among aquaculture facilities and between domesticated and wild salmon populations. Effective disease management is challenged by uncertainty in the salmon farms' relative contributions of infectious agents into the environment, versus background levels. Recent technological advances allow for screening of infectious agents using high-throughput quantitative PCR methods, and recent research has detected high diversity and abundance for a suite of agents both within domestic fish and in environmental DNA adjacent to facilities. Here, I empirically characterize the dispersal of infectious agents originating from salmon farms and estimate the spatial extent of potential increased infection risk to migrating wild juvenile salmon.

Affiliation

University of Toronto

Presentation type

Oral

Improving the use of cladoceran size structure as an indicator of trophic change: a case study from the Bay of Quinte, Lake Ontario

Isaac Armstrong[1], Brian Cumming[1]

[1]Queen's University

Changes in cladoceran size structure are often used to infer shifts in predation regime. In systems with strong bottom-up drivers, trends in size metrics can be harder to distinguish, making it difficult to understand how upper trophic levels have responded to changes in production. The Bay of Quinte on northern Lake Ontario is a severely anthropogenically impacted system which has experienced both bottom-up and top-down forces and whose food web is considered highly impaired. We measured a suite of cladoceran size metrics in a dated sediment core from the Bay of Quinte in comparison with historic monitoring records to characterize trends and drivers of size structure change. As a novel method, we identified differences in predation sensitivity and morphological response of different size classes (as a proxy for instar) of *Bosmina longirostris* and *Eubosmina coregoni*. Overall, juvenile *Eubosmina* carapace length and % *cornuta*-form *Bosmina* were positively associated with fish planktivory, while juvenile *Bosmina* mucro length, juvenile *Bosmina* mucro:carapace, adult *Eubosmina* carapace length, and *Chydorus sphaericus* rostrum length were negatively associated with fish planktivory. The Bay of Quinte size structure record displays a shift from a turbid, planktivore-dominated state to a clear state with increased piscivory, however trends in modern-day intervals suggests heightened variability of food web drivers. Broadly, our research provides new methods to strengthen the use of cladoceran size structure as an indicator of trophic change.

Affiliation

Queen's University

Presentation type

Oral

Heuristic food webs: a tool to investigate the resilience of macroinvertebrate communities in the Peace-Athabasca Delta wetland system

Tim Poirier[1], Zacchaeus Compson[2], Wendy Monk[3], Donald Baird[3]

[1]University of New Brunswick, [2]Advanced Environmental Research Institute, University of North Texas, [3]Environment and Climate Change Canada @ Canadian Rivers Institute, University of New Brunswick

Food webs provide a tool to quantify structural and functional changes and allow a diagnostic approach in our observation of change. Environmental DNA (eDNA) metabarcoding can support food web development by providing consistently observed, high resolution data across space and time. Macroinvertebrate eDNA data paired with environmental variables collected from 40 shallow freshwater wetland sites, including eight core sites, sampled over an eleven-year period across the Peace-Athabasca Delta (PAD) will be used to develop heuristic food webs to assess changes within. We will explore the following questions: 1. Which geospatial variables are driving macroinvertebrate biodiversity patterns? And 2. How resilient are macroinvertebrate communities within the PAD? Multivariate statistics will be used to detect changes in biodiversity over space and time as well as pair environmental and biodiversity data to determine environmental stressors that led to changes in biodiversity. Additionally, heuristic food-webs will be constructed using the R package *cheddar* by following a previously developed pipeline using functional traits to determine an organism's functional niche. Connectance and average vulnerability are properties of heuristic food webs that are sensitive to change. Variations in their values after known perturbations will be analysed to determine the resilience of the PAD communities. We expect to observe measurable changes in macroinvertebrate biodiversity caused by environmental factors and that the PAD communities are resilient to change. Our findings will benefit management efforts in the PAD and comparable wetlands globally, with the addition of broadening our understanding the relationship between community structure and system resilience.

Affiliation

University of New Brunswick

Presentation type

Poster

The effects of triploidization and probiotics on the gut microbiome of Chinook salmon (Oncorhynchus tshawytscha) fry

Edel Bai[1], Daniel Heath[1], Javad Sadeghi[2], Brian Dixon[3], John Heath[4], Matthew Yates[1]

[1]University of Windsor, [2]University of British Columbia, [3]University of Waterloo, [4]Yellow Island aquaculture

Over the last decade, the need for more environmentally friendly fish culture has grown. One solution to reduce potential environmental impacts of salmon farming is triploidization, where fish retain a 3rd set of chromosomes and are functionally sterile. For Chinook salmon (*Oncorhynchus tshawytscha*), triploidization prevents sexual maturation, preventing escaped fish from breeding with wild populations, as well as avoiding loss of flesh quality associated with maturation. However, triploid Chinook salmon suffer from impaired immune function, making them more vulnerable to diseases; probiotic treatments have been proposed to counter this deficiency. The objective of this project was to determine the effect of triploidy, probiotics, and their interactions, on the intestinal microbiome of farmed Chinook salmon. We separated Chinook salmon fry from 12 families into 4 treatment groups: (1) diploid-regular feed, (2) diploid-probiotic feed, (3) triploid-regular feed, and (4) triploid-probiotic feed and reared them in replicate tanks. DNA from the intestinal microbiome was extracted and 16S metabarcoded using the hypervariable region V5-V6 bacterial genome region. Results indicate that both triploidy and probiotic treatment affects the gut microbiome bacterial community at the alpha and beta diversity levels. The feed-by-ploidy interaction and maternal effects also affected bacterial community beta diversity. This study broadens our understanding of how triploidy interacts with the gut microbiome and the potential for probiotics to reverse those effects, ultimately adding to our ability to improve triploid aquaculture and produce more fish while limiting our impact on natural populations of salmon.

Affiliation

University of windsor

Presentation type

Oral

Dropping it Low: Implications of drawdown on GHG emissions from two multi-purpose reservoirs in southern Ontario

Raisa Islam[1], Tonya DelSontro[1]

[1]University of Waterloo

Freshwater impoundments are significant sources of greenhouse gases (GHGs) from inland waters to the atmosphere, due to large amounts of terrestrial organic carbon (OC) being flooded during their construction, resulting in the rapid microbial decomposition of OC and the subsequent release of CO_2, CH_4 and N_2O via multiple pathways. An emerging theme in understanding GHG dynamics from impoundments pertains to the effects of human-controlled drawdown, since, compared to natural water bodies, reservoirs experience substantial water level fluctuations, which reduces hydrostatic pressure on the water column such that CH_4 emission via ebullition (bubbling) is enhanced. Drawdown brings about a complexity in understanding how GHG emissions respond to physical and chemical factors, such as seasonal stratification, nutrient and/or OC loading, as well as regional weather events.

To elucidate how reservoir drawdown can affect the various pathways of GHG emissions, we study the surface waters and water columns of Conestogo and Belwood Reservoirs, located in the Grand River watershed in southern Ontario. Both reservoirs are multi-purpose impoundments intended for flood-control and low-flow augmentation, and experience significant drawdown (>10m of water level) during the open water season. Here, we present direct littoral and pelagic GHG flux measurements, dissolved gas and nutrient depth profiles, and continuously monitored water column temperature and dissolved oxygen to shed light upon the evolution of greenhouse gases in Conestogo and Belwood during the open water season of 2023. Understanding the effects of drawdown can aid in narrowing down best management practises to lower the footprint of reservoirs on the climate.

Affiliation

University of Waterloo

Presentation type

Oral

Lab-based and field-based studies use transcriptomics to identify and evaluate the utility of noise-responsive molecular biomarkers in snow crab (Chionoecetes opilio) hepatopancreas and hemocytes

Matthew Rise[1], Jennifer Hall[2], Sarah Lehnert[3], Emmanuel Gonzalez[4], Jacqueline Hanlon[3], Surendra Kumar[1], Corey Morris[3]

[1]Department of Ocean Sciences, Memorial University of Newfoundland, St. John's, NL, Canada, [2]Aquatic Research Cluster, Core Research Equipment and Instrument Training (CREAIT) Network, Ocean Sciences Centre, Memorial University of Newfoundland, St. John's, NL, Canada, [3]Fisheries and Oceans Canada, Northwest Atlantic Fisheries Centre, St. John's, NL, Canada, [4]Canadian Centre for Computational Genomics, McGill Genome Centre, Montréal, QC, Canada

There has been concern that seismic oil and gas exploration off the east coast of Newfoundland and Labrador could impact that region's economically important snow crab fishery. To investigate the potential impact of noise on the snow crab immune system, we employed a combination of lab- and field-based studies (Hall et al., 2021, 2023). Adult crab were exposed to 2D or 3D seismic surveying in the field, or recorded seismic airgun firing in the lab, with non-exposed controls (see references for details). RNA-sequencing (RNA-seq) was used to identify hepatopancreas transcripts differentially expressed in exposed vs. non-exposed crab from both lab- and field-based studies, as well as noise-responsive hemocyte transcripts in the lab-based study. Hundreds of candidate noise-responsive genes were identified by RNA-seq. Real-time quantitative polymerase chain reaction (qPCR) and multivariate statistical analyses were used to investigate the performance and utility of dozens of these molecular biomarkers. While some RNA-seq identified noise-responsive biomarkers were qPCR-confirmed (e.g. *rgs2* was significantly upregulated in noise-exposed hepatopancreas and hemocytes), few biomarkers showed consistent results in field-collected samples (Hall et al. 2023). Still, both lab- and field-based studies identified and confirmed noise-responsive biomarkers (many with immune and stress relevant functional annotations) that are valuable tools for understanding how ocean noise influences snow crab physiology and health.

Hall JR, Lehnert SJ, Gonzalez E, Hanlon JM, Kumar S, Morris CJ, Rise ML. 2023. *Frontiers in Marine Science* 10, 1198036.

Hall JR, Lehnert SJ, Gonzalez E, Kumar S, Hanlon JM, Morris CJ, Rise ML. 2021. *Fisheries Research* 234, 105794.

Affiliation

Memorial University of Newfoundland

Presentation type

Oral

Responses of subfossil invertebrates to legacy DDTs and land-use change in remote lakes from New Brunswick, Canada

Katlyn Morrow[1], Joshua Kurek[1]

[1]Mount Allison University

DDT is an organochlorine insecticide that causes adverse effects on organisms and can persist in aquatic environments for decades. This insecticide was used heavily throughout New Brunswick from 1952 to 1968 to manage outbreaks of eastern spruce budworm. Using dated sediment cores from four headwater lakes, this study aims to investigate the long-term changes in midge and zooplankton assemblages as they relate to inputs of DDT, as well as land-use change that we hypothesize leads to greater levels of DDT from the catchment. Preliminary results show that probable effect levels were exceeded by ~7, ~65, 300 and ~450 times during the peak DDT period. Modern lake sediments remain elevated in DDD and DDE at levels known to impact production and composition of benthic invertebrates. Our goal is to determine how key trophic levels were affected by legacy DDT and to understand lake recovery in an ever-changing world.

Affiliation

Mount Allison University

Presentation type

Poster

Seasonal Patterns and Regulation of CH4 oxidation in 6 Reservoirs in Canada

Samuel Cuerrier[1], Paul del Giorgio[1], Yves Prairie[1]

[1]Université du Québec à Montréal

Under stratified conditions, the flow of dissolved gases across density gradients in the water column is impeded, leading to storage of CH4 and CO2 in bottom waters. The accumulated dissolved gas can then be emitted to the atmosphere during overturn periods and, for hydroelectric reservoirs, from the discharge waters. The vertical changes in concentration of each dissolved gas at any given time and depth depends both on the rates of biogeochemical processes simultaneously producing or consuming gas, and on the rates at which dissolved gases are exchanged among water parcels. Applying a mass balance approach, we investigate the potential role of biological processes and hydrodynamics on gas dynamics in the water column during period of stratification and mixing in six Canadian reservoirs. Here, we show that overall CH4 budget is largely regulated by CH4 biological consumption, that is not only in the well-oxygenated water column, but in some cases in deeper, anoxic waters as well. Furthermore, we show that biological CH4 consumption is an important but seasonally variable sink of CH4. We expect our results to improve our current understanding of the processes regulating reservoirs CH4 budgets, which is essential to provide a practical framework for exploring whether some changes in reservoir operational procedure can be leveraged to reduce a reservoir's carbon footprint.

Affiliation

Université du Québec à Montréal

Presentation type

Oral

An investigation into River herring fish passage following the removal of a hydropower dam at Salmon Falls, St Croix | Skuitik River, New Brunswick: Results from the first trial year of study

Many hydropower facilities in North America are nearing their life expectancy. Accordingly, dam removals are expected to become increasingly common in the next few decades. However, while it is hypothesized that these dam removals will fully restore fragmented fish populations, quantitative demonstrations of restored fish passage are lacking. Moreover, where hydropower was constructed at falls and rapids, some riverbed reconstruction may to be required to restore passage. In this study we use radio-telemetry to assess fish passage of blueback herring and Atlantic alewife (n=32) at a specially designed and reconstructed river bed at Salmon Falls, following the removal of small hydropower plant on the St Croix River in Brunswick. We use a series of fixed radio-telemetry stations to quantify passage rates and duration above and below the existing dam, using a time-to-event approach. Our trial year findings, provide useful insight into the design of fish passage targets for the restored riverbed, along with a general increase in our understanding of alosid ecology in the St Croix river and beyond.

Affiliation

Canadian Rivers Institute, University of New Brunswick

Presentation type

Oral

Gene transcription response to environmental stress gradients in wild yellow perch (Perca flavescens) populations

Patricia Voyer[1], Daniel Heath[1], Olivier Morissette[2], Timothy Johnson[3], Jonathon LeBlanc[1]

[1]University of Windsor, [2]Université du Québec à Chicoutimi, [3]Ministry of Natural Resources and Forestry

Over time, the intensification of environmental stressors has put fish populations at risk of decline and decreased health. Temperature and agricultural pollution remain prominent stressors in freshwater ecosystems, with their intensity representing a wide gradient of conditions. To effectively respond to an environmental challenge, fish must initiate a physiological change through transcriptome alteration. Given the sensitive nature of gene transcription, quantification of this process via transcriptional profiling can provide an integrated measure of how fish are responding to such challenges. Our study will explore how yellow perch (*Perca flavescens*) are transcriptionally responding to increasing temperature and nutrient pollution changes over a gradient. For this study, yellow perch tissue samples (liver and gill) were collected from the Bay of Quinte following a natural temperature gradient, and from Lac St-Pierre along an agricultural nutrient pollution gradient. We are designing a qPCR OpenArray assay targeting 25 temperature and pollution stress response candidate genes in Perciformes. Through careful selection of hypoxia, detoxification, thermal stress, and immune response candidate genes, this assay will provide insight into whether fish are exhibiting an adaptive coping response to environmental challenges, or unregulated cellular stress. We predict that fish sampled from populations experiencing the most extreme levels of selected environmental stressors will exhibit the greatest departure from their resting transcriptional profiles, relative to their respective control environments. This study will enable us to predict the point at which stressors negatively impact fitness in wild fish populations, thus providing insight into how fish will respond to increasing climate change pressures.

Affiliation

University of Windsor

Presentation type

Oral

Leveraging new technologies to enhance community-based monitoring of freshwater biodiversity

Donald Baird[1], Wendy Monk[1]

[1]Environment & Climate Change Canada

Globally, freshwater biodiversity has never been under greater threat, yet in Canada, we lack data to assess how our freshwater ecosystems are faring in the Anthropocene. Canada's unique geography and remoteness has resulted in our rivers, lakes and wetlands suffering a deficit of consistent observational data to effectively assess current and future status and trends in biodiversity. Historical efforts to increase understanding through 'top-down' biological surveys have provided critical information in terms of species lists but has generated an inconsistent patchwork of knowledge which has proved impossible to scale due to the sheer cost of mounting survey efforts across a land mass of over 9 million km^2. Recently, however, we are seeing a rapid acceleration of community science-generated data, which is now being linked through accessible data hubs for the benefit of all. In this session, we will explore how this flourishing sector can be further supported and enhanced through the application of new technologies, such as nature photography apps, remote sensing and environmental DNA analysis. These observation approaches are beginning to fill a critical gap in our knowledge of Canadian freshwaters, which will be essential for adaptation to future challenges facing our planet.

Affiliation

Environment & Climate Change Canada

Presentation type

Oral

Impacts of the Canso Causeway on marine migrations

Erin Stevens[1], Kathleen Glasgow[1], Christopher Marchand[1], Regina Cozzi[1], Heather D Penney[1]

[1]St. Francis Xavier University

In the 1950s the federal government built a 1.3 kilometer causeway between mainland Nova Scotia and the island of Cape Breton. Due to cost, ice, and length, the government opted for a rock-fill causeway rather than a bridge. Unfortunately, the Strait of Canso was an important pathway for seasonal migrations between the Gulf of St. Lawrence and the North Atlantic Ocean. There is little in the literature about the impacts of the causeway on the animals that relied on the strait for movement. Now, each year around November there is an annual pulse of biodiversity as fishes such as Atlantic saury and mackerel attempt to enter the strait and get trapped by the causeway. Marine mammals, sharks, and sea birds now also gather here to take advantage of the trapped fish. In the fall of 2023, we are collecting data such as temperature, salinity, and plankton composition before, during, and after the migration on each side of the causeway to determine factors that are driving the migration. We are also doing an inventory of species present at each time point. We will be collecting historical data to examine changes over time of species present and the timing of migration which is moving later and later every year based on anecdotal evidence. The impacts of the barrier on marine animal passage has not yet been studied, and this is the first step toward this goal.

Affiliation

St. Francis Xavier University

Presentation type

Poster

First observations of European-American Eel hybrids in North America using eDNA metabarcoding and low-coverage whole genome sequencing

Samantha Crowley[1], Tony Kess[2], Paul Bentzen[1], Ian Bradbury[2]

[1]Dalhousie University, [2]Fisheries and Oceans Canada

American and European Eels (*Anguilla rostrata* and *Anguilla anguilla*) are sister species of catadromous eels occurring in the North Atlantic. Both species are of global conservation concern, with *A. rostrata* listed as “endangered” and *A. anguilla* as “critically endangered” by the IUCN. Both species spawn in the Sargasso Sea, with larvae drifting passively via currents to their freshwater habitats in North America and Europe. Currently there is no evidence for local adaptation in either species, and both are considered genetically panmictic. Additionally, the two species are known to hybridize, with the vast majority of hybrid individuals found in Iceland, thought to be because of its roughly intermediate location between Europe and North America. While low levels of American Eel admixture have been detected in European Eels and vice versa, to date there have been no reported incidences of hybrids turning up in large numbers outside of Iceland. In this study, we detected European Eel mitochondrial DNA at eight locations in southern Newfoundland using eDNA metabarcoding in 2020; these detections were subsequently confirmed in the region using low-coverage whole genome sequencing of eels collected from southern Newfoundland rivers in 2022. Levels of European admixture are consistent with the presence of F1 and backcross (American direction) hybrids. This new insight on an expanded distribution of hybrid anguillid eels in the North Atlantic extends our knowledge of these two at-risk species and will be key for informing conservation and management.

Affiliation

Dalhousie University

Presentation type

Oral

Combining community-based monitoring with DNA metabarcoding to study riverine biodiversity in benthic macroinvertebrate communities of the Canadian Maritimes

Brianna Levenstein[1, 2, 3], Jacqui Levy[1], Wendy A. Monk[1, 2, 3], Royce Steeves[4], Nellie Gagné[4], Teresita M. Porter[5], Mehrdad Hajibabaei[5], Erik J.S. Emilson[6], Alex Bush[7], Edith Lacroix[1], Donald J. Baird[1, 2, 3]

[1]Environment and Climate Change Canada, [2]Canadian Rivers Institute, [3]University of New Brunswick - Fredericton, [4]Fisheries and Oceans Canada, [5]University of Guelph, [6]Natural Resources Canada, [7]Lancaster University

In the Canadian Maritimes, freshwater ecosystems face multiple stressors arising from intensive agriculture, forestry, urbanization, and climate change, yet the downstream consequences for freshwater biodiversity remain poorly understood. To begin to address this challenge, quantifying freshwater biodiversity is needed over a large area, requiring collaborative efforts using tools that are precise, consistently applied and accessible. Environmental DNA (eDNA) extracted from bulk benthic macroinvertebrate (BMI) samples provides high resolution freshwater biodiversity information. This study took advantage of the collaborative efforts and standardized protocol of the Canadian Aquatic Biomonitoring Network (CABIN) to explore the ability of eDNA data to identify changes in biodiversity along environmental gradients. Benthic kick net samples were taken from streams in Nova Scotia, New Brunswick, and PEI from 2016-2019 by CABIN network partners, including community groups. Samples were collected from sites influenced by agriculture, forestry, and urbanization as well as relatively unimpaired reference sites. Samples were analyzed using DNA metabarcoding with multiple COI primers to maximize taxon detection, and amplicon sequence variants were assigned to the genus-level using the MetaWorks 1.9.3 pipeline. Using geospatial tools, we extracted environmental data for each site to assess changes in biodiversity over environmental gradients. Agriculture had the strongest effect on BMI communities at our impaired sites, with sensitive taxa decreasing with increasing agricultural intensity. We also detected certain taxa more frequently at reference than test sites. We conclude that high resolution biodiversity information derived from eDNA can be an effective tool to detect anthropogenic impacts in stream environments assessed by community-based monitoring.

Affiliation

Environment and Climate Change Canada, Canadian Rivers Institute, UNB - Fredericton

Presentation type

Oral

Evaluating the impact of development on Halifax lakes using the core microbiome concept

Lindsay Johnston[1], Yannan Huang[1], Casey Doucet[1], Rob Jamieson[1]

[1]Dalhousie University

Although urban lakes are highly valued by nearby residents, they are seldom unimpacted, as stormwater runoff, and in some cases wastewater effluent, are discharged to these water bodies. The Halifax Regional Municipality (HRM) is home to more than 1000 lakes, with many located within the urban core of the city. As development continues to accelerate with little attention paid to downstream impacts, we anticipate further degradation of these natural water bodies. This shift may favour microbial assemblages that are undesirable for lake users, e.g., toxic cyanobacteria. A synoptic water quality survey of 51 Halifax lakes has been conducted on a decadal basis since 1980. The survey, taking place immediately after ice-out, has documented changes to water chemistry and trophic status over a 40-year period corresponding with rapid urbanization in the HRM. Following the most recent survey (2021), we selected 12 of the 51 lakes for continued monitoring, representing a range of morphologies, trophic status, degree of development, and water colour. Water samples were collected for 16S rRNA MiSeq next-generation sequencing throughout the water column during peak stratification and fall turnover. Here we present this data and propose use of the core microbiome concept to evaluate the impact of development on Halifax lakes and their potential for cyanobacterial proliferation. We examine bacterial abundance and community structure at varying temporal and spatial scales to establish a core microbiome for Halifax lakes, and assess the relationships between cyanobacterial abundance and alterations to this core microbiome.

Affiliation

Dalhousie University

Presentation type

Oral

Strengthening our ability to detect change from streams to landscapes using eDNA for bioassessment

Wendy Monk[1], Alex Bush[2], Brianna Levenstein[3], Jacqui Levy[3], Royce Steeves[4], Nellie Gagné[4], Teresita Porter[5], Michael Wright[5], Mehrdad Hajibabaei[5], Erik Emilson[6], Édith Lacroix[3], Donald Baird[1]

[1]Environment and Climate Change Canada @ Canadian Rivers Institute, University of New Brunswick, [2]Lancaster University, [3]Environment and Climate Change Canada, [4]Fisheries and Oceans Canada, [5]University of Guelph, [6]Natural Resources Canada

With consistent taxonomic and increasing detectability per sample, eDNA metabarcoding methods have been shown to improve the quality and utility of ecological data in freshwater ecosystems. This high-resolution information allows us to quantify the dynamics of communities across different spatial and temporal scales. Using freshwater benthic macroinvertebrate biomonitoring data from wadeable streams across Maritime Canada, we explore the development and application of reference condition models and associated assessment tools to identify sites that are potentially degraded using both traditional morphology and eDNA-based data. Enhanced detection and improved taxonomic resolution through eDNA-based models often reflected greater sensitivity to impairment, even with presence-absence data. Quantitative responses using relative abundance data were also of interest when answering targeted questions. Representing the first regional application of eDNA for biomonitoring, these results help provide the foundation to model potential impacts from ongoing climate warming and support future nature-based solutions for climate adaptation as well as highlighting the significance of community-based monitoring for large-scale bioassessment.

Affiliation

Environment and Climate Change Canada @ Canadian Rivers Institute, University of New Brunswick

Presentation type

Poster

Assessing gas composition of bubbles to better estimate ebullitive fluxes from reservoirs

CH_4 ebullitive fluxes represent a considerable emission pathway for many lakes and reservoirs. Despite their importance, ebullitive fluxes remain poorly constrained, due to their stochastic nature. Measuring bubble fluxes has traditionally relied on intensive field efforts, especially when conducting large-scale surveys. Therefore, ebullitive fluxes have often been set aside in GHG flux estimations. In other cases, some have provided an estimation based on theoretical models which depend mainly on physical principles. However, the flux provided by these models still lack resolution in their coverage. Thus, assessing the uncertainties of general models with field data allows us to fine-tune models according to variable environmental parameters and provide a more reliable number. For instance, measuring diverse gas in bubbles collected at random sites across reservoirs and along transects during multiple field campaigns allows us to capture spatio-temporal patterns. Assessing the common assumption that N_2 in porewater is in equilibrium with the atmosphere at any given time and place has rarely been validated. Consequently, measuring the fraction of CH_4, N_2 and CO_2 in bubbles to capture the concentrations in the sediments can have a significant impact on a reservoir's predicted emissions. I will present early results on bubble gas composition from 6 reservoirs located in Ontario and Québec

Affiliation

UQAM

Presentation type

Oral

Exploring approaches for braiding knowledge systems to support environmental and cultural flows

Wendy Monk[1], Rebecca Tharme[2], Erin O'Donnell[3], And co-authors[4]

[1]Environment and Climate Change Canada @ Canadian Rivers Institute, University of New Brunswick, [2]Riverfutures, Australian Rivers Institute, [3]University of Melbourne, [4]Federal, Indigenous and consulting organisations

Water has shaped our societies since time immemorial, helping to create and influence our cultures, our spiritual connections to places, our livelihoods and economies and our well-being. This water is an integral, living element of all our freshwater ecosystems, each of which needs a regime of water flows and levels of a specific magnitude, pattern, timing, and quality to maintain their essential biophysical features, processes, and biocultural diversity. Environmental flows and cultural flows methods and implementation continue to evolve through research and practice that actively ensures more meaningful inclusion of social, cultural, and spiritual considerations. While gradual, this transformation of the field has progressed to the extent that the internationally accepted definition of environmental flows now makes explicit reference to such factors and their critical links to the sustainability and health of freshwater ecosystems. This is also reflected in the increasing research emphasis within eflows on social and cultural connections and interdependencies from different perspectives, worldviews, and ways of knowing and valuing ecosystems. Despite this trend towards working with broader perspectives across different knowledge systems, including Indigenous knowledge, Indigenous science and Western science, there remains a strong Western science focus in thinking and in practice, methodologically and in terms of processes supporting implementation. Braiding and weaving of knowledge systems are increasingly being shown to be powerful ways to bridge differences in our understanding. Indeed, these approaches build upon the strengths of each system of knowledge and enable reciprocal learning while maintaining the integrity and insights of each of them.

Affiliation

Environment and Climate Change Canada @ Canadian Rivers Institute, University of New Brunswick

Presentation type

Oral

Towards sex identification of the American eel using epigenomics

Gabriela Ulmo Diaz[1], Eric Normandeau[1], Julie Turgeon[1], Louis Bernatchez, posthumous[1]

[1]Université Laval

The skewed sex ratios observed in most species of the genus Anguilla are of concern for its conservation and for commercial aquaculture purposes. Sex identification in temperate eels is notoriously difficult, with early sex assessment being possible only through gonadal examination in the immature adult yellow stage. Recently, less invasive transcriptomic markers were developed, but still require gonadal tissue or development to the silver stage. Here, we used bisulfite sequencing to obtain the whole genome methylome from the muscle tissue of 34 captive yellow American Eel individuals whose sex was later determined. We identified differentially methylated loci and genomic regions with different levels of methylation between males and females. Epigenomics thus could potentially allow for eel sex identification with a simple tissue biopsy that can be performed before silvering and without culling the specimen. Further examination of differential methylation in muscle tissues could shed light on the long-debated mechanisms and triggers of sex determination in temperate freshwater eels.

Affiliation

Université Laval

Presentation type

Oral

Using eDNA metabarcoding to monitor Canadian Atlantic marine conservation areas

Jonathan Fisher[1], David Cote[2], Gordon de Jong[1]

[1]Centre for Fisheries Ecosystems Research, Fisheries and Marine Institute of Memorial University of Newfoundland, Newfoundland and Labrador, Canada, [2]Northwest Atlantic Fisheries Centre, Fisheriesand Oceans Canada, St. John's, Newfoundlandand Labrador, Canada

Establishing marine conservation areas (MCAs) is one of the measures taken by Canada to achieve the goal of conserving 30% of our ocean area by 2030. However, consistent monitoring is required to evaluate whether these MCAs are benefiting biodiversity. Environmental DNA (eDNA) metabarcoding is a powerful tool that can aid in surveying remote environments, including the deep ocean. Within a wider program aimed at monitoring and assessing MCAs, the goal of this project is to provide a stronger understanding of the applications of eDNA metabarcoding for monitoring MCAs in the Newfoundland and Labrador region. Specifically, we focus on how different eDNA methodologies affect the detection and quantification of marine community composition. To achieve this, we pair experimental collections of seawater samples of ~10-fold different volumes with field collections at various depths within MCAs spanning thousands of km^2. COI, 18S, and 12S markers will be applied to all samples to characterize the metazoan and fish communities. This study will fill key knowledge gaps on the benefits and inherent limitations of eDNA metabarcoding methodologies to monitor Canadian MCAs, including the effects of sample volume on taxa detections. Further, our results will provide novel insights into the spatial differences in communities detected in the MCAs and remote environments, thereby informing future sampling designs. These applications of eDNA metabarcoding will contribute to the monitoring and assessment needs within Canada's MCAs now and as Canada advances the conservation goals of protecting 30% of the ocean by 2030.

Affiliation

Centre for Fisheries Ecosystems Research, Fisheries and Marine Institute of Memorial University of Newfoundland, Newfoundland and Labrador, Canada

Presentation type

Poster

Variation in the diet of American Lobster and Atlantic Rock Crab in two Prince Edward Island sites in the southern Gulf of St. Lawrence

Stephanie Boudreau[1], Natalie Asselin[1], Patricia Hanley[1]

[1]Fisheries and Oceans Canada

The southern Gulf of St. Lawrence (sGSL; Atlantic Canada) coastal zone is home to both the American lobster (*Homarus* americanus) and Atlantic rock crab (*Cancer irroratus*). Lobster rely on rock crab as a dietary component essential for growth and reproduction. Lobster abundance indicators have been increasing over the past decades. In contrast, current evidence suggests local declines in rock crab abundance, a trend with unknown consequences to lobster body condition.

To learn more about the current diet of lobster and rock crab in the sGSL, and the impacts of diet on lobster condition, Fisheries and Oceans Canada Gulf Region, in partnership with the Prince Edward Island (PEI) Fishermen's Association and the Government of PEI Department of Fisheries and Communities, sampled two contrasting sites along the coast of PEI in October of 2019 and 2021: Nine Mile Creek (less rocky habitat, lower lobster density) and Alberton (structured habitat, higher lobster). Lobster and rock crab densities were calculated from SCUBA transects, rock crab densities were similar between the sites. Lobsters were collected (195 in Alberton, 249 in Nine Mile Creek) field dissected at both sites to collect biological information, stomachs for visual assessment of contents, and hepatopancreas for water and lipid analyses. In Nine Mile Creek, 431 rock crab were collected for stomach dissections in Nine Mile Creek and 12 were collected in Alberton. To supplement the information gained from the visual assessments of stomach contents, muscle from all lobsters, and a subsample of rock crab, were retained for stable isotope analysis.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

How much is enough? Examining the sampling effort necessary to estimate mean eDNA concentrations in lentic systems

Matthew Yates[1], Maxime Gaudet Boulay[2], Erik Garcia Machado[2], Guillaume Côté[3], Amélie Gilbert[4], Louis Bernatchez[2]

[1]University of WIndsor, [2]Université Laval, [3]Ministère de l´Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs, [4]Société des établissements de plein air du Québec (Sépaq)

The concentration of eDNA in an environment can provide important ecological information of relevance for management and conservation, but little research has explored optimizing sampling strategies to estimate mean eDNA concentrations in natural environments. Inter-replicate eDNA concentrations often exhibit right-skewed 'clustered' or 'clumped' distributions, with important potential implications for modelling the resulting sampling effort necessary to accurately quantify eDNA concentrations. In a previous study, 17-20 Brook Charr eDNA samples were collected from 28 lakes in Québec, Canada. We explored how variation in eDNA concentrations within a lake was affected by several habitat characteristics. We then conducted a power analysis to determine the sampling effort ('minimum n*') necessary to accurately quantify mean lake eDNA concentrations and, using simulations, explored how a bimodal distribution of eDNA particle copy count could affect inter-replicate variability. The median sample size such that 90% of sample mean estimates were within 20% of the 'true' mean was 12.5; a sample size of 20 was sufficient to quantify mean concentrations in 21/28 lakes. We found no evidence that temperature or lake size impacted sample variability. We also found that variance among replicates was non-linearly related to mean lake eDNA concentration across years: variability was lowest at low and high concentrations and highest at intermediate concentrations. We hypothesize that this resulted from the stochastic capture of large 'aggregate' particles at intermediate concentrations. Overall, we conclude that sampling efforts in many previous studies (notably including the authors' own) were potentially low, emphasizing the need to increase spatial replication in surveys.*

Affiliation

University of Windsor

Presentation type

Oral

Understanding the response of downstream aquatic ecosystems to defoliation by Eastern Spruce Budworm to inform outbreak management strategies.

Erik J.S. Emilson[1], Karen Kidd[2], Kaiying S. Ju[2], Roxane Maranger[3], Madison McCaig[1, 2], Colin McCarter[4], Sandrine Ouimet[3], Harvinder K. Sidhu[2], Emily Smenderovac[1], Michael Stastny[5], Venier Lisa[1]

[1]Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, Sault Ste. Marie, Ontario, Canada, [2]Department of Biology, McMaster University, Hamilton, Ontario, Canada, [3]Département des sciences biologiques, Université de Montréal, Montréal, Québec, Canada , [4]Department of Geography & Department of Biology and Chemistry, Nipissing University, North Bay, Ontario, Canada, [5]Natural Recources Canada, Canadian Forest Service, Atlantic Forestry Centre, Fredericton, New Brunswick, Canada

Eastern spruce budworm (SBW) is one of the most prevalent agents of natural disturbance in Canadian forests with annual area affected surpassing that of fire and harvest combined, and the prevalence of outbreak is expected to increase with climate change. Management strategies to control outbreaks that are designed to minimize broader economic, ecological, and social impacts are becoming increasingly important. These strategies differ primarily in the degree to which defoliation is suppressed, but little is known about the downstream ecological consequences of the management of defoliation. To fill a knowledge gap on the broader implications of these management decisions, we experimentally manipulated a gradient of defoliation among 12 watersheds in the Gaspésie Peninsula, Québec, where an outbreak of SBW has been occurring for several years. We measured dissolved organic matter (DOM), microbiome structure and function, physical habitat, and water chemistry as indicators of ecosystem functions in the associated streams, and related differences among sites to defoliation. We found that annual discharge, the aromaticity of DOM, temperature, and algal biomass all increased with defoliation. The structure of biofilm microbiomes changed subtly with defoliation, and these changes suggest alterations in carbon use. Here we explore linkages of these changes to broader consequences within the streams, including food web structure, carbon fate, and greenhouse gas concentrations, and highlight the importance of incorporating broader land-water linkages into forest pest management decisions.

Affiliation

Natural Resources Canada

Presentation type

Oral

Examining the efficiency of gill net-based community surveys for fish biodiversity assessment in northeastern Ontario shield lakes

Emily Fields[1], Tom Johnston[1]

[1]Laurentian University

Inland lakes and their associated fish communities constitute a valuable natural resource for Canada. Long-term monitoring of Ontario lakes provides important information that supports both fisheries management and biodiversity assessment. These monitoring programs have traditionally relied on gill net surveys conducted on larger lakes (> 100 ha) that support sportfish populations, but gill net surveys can be ineffective at sampling certain lake habitats or fish species. As a result, reliance on gill net, or single-gear protocols, may be underestimating species richness in lakes. There is some evidence that using a multi-gear protocol may increase species richness estimates and may be better suited for biodiversity assessment. We compared biodiversity measures derived from Broad-scale Monitoring (BsM) gill net surveys with those derived from BsM surveys supplemented with other sampling protocols designed to sample habitats and species that are believed to be poorly sampled by gill nets. Sampling was carried out on 30 lakes in the historical acid-damaged zone of northeastern Ontario, Canada. The addition of supplemental sampling protocols increased species detection in lakes by 18-116% and added on average 4 additional fish species, indicating that a combination of sampling protocols improves estimates of fish species richness. Our approach addresses the limitations of the current monitoring program for biodiversity assessment and aims to provide a more comprehensive approach to precisely quantifying fish species richness.

Affiliation

Laurentian University

Presentation type

Oral

Thermal Ecology of Freshwater Benthic Macroinvertebrates in Maritime Canadian Rivers

Freshwater ecosystems are increasingly at risk of shifts in their thermal regimes due to destabilizing climate and increasing impacts from anthropogenic disturbances. Benthic macroinvertebrates (BMI) dominate freshwater biodiversity and include aquatic insects, molluscs, crustaceans, and annelids - and are crucial to the health of freshwater systems worldwide. Shifts in water temperature thresholds for individual genera outside of their normal range can challenge their reproductive success, resource allocation, and survival leading to risks of overall BMI assemblage shifts and wider system instability.

The objective of the project is to study historical and current BMI community structure under varying thermal conditions. BMI and paired site characteristic data collected across 25 years from Canadian Maritime rivers available through the Canadian Aquatic Biomonitoring Network (CABIN) is used to identify thresholds for community change and taxa presence or absence. Theses thresholds for BMI genera are then used in the development of a prototype index; the goal of which is to more accurately identify critical biomonitoring sites nearing or past important indicator taxa temperature thresholds. The aim of this research is to examine relationships between temperature and BMI at the individual and community level, and referencing to site specific community structure, to understand thresholds for current and future climate.

Affiliation

University of New Brunswick

Presentation type

Poster

Implications of a fluctuating estuarine environment on the upper thermal tolerance in the invasive green crab (C. maenas)

Robert Griffin[1], Rasmus Ern[2], Fredrik Jutfelt[2], Tamzin Blewett[1]

[1]University of Alberta, [2]Norwegian University of Science and Technology

The introduction of invasive species can have a devastating impact on an ecosystem andnative fisheries, often through predation and competition with native organisms. The European green crab (Carcinus maenas) is an extremely successful invasive species, thriving in marine environments around the world, and known for their tolerance to environmental stress. The success of an invasive species often depends on their ability to thrive in new environments. Using a multi-stressor approach, we evaluated the upper thermal tolerance of the green crab in combination with various environmental challenges present within estuarine environments. In particular, we investigated how changes in environmental salinity, dissolved oxygen, and waterborne copper influence the critical thermal maximum (CT max)and fitness of the green crab. First, six male crabs were assigned to each of the following treatment groups, control, 50% oxygen saturation, 150% oxygen saturation, 50% salinity, 20% salinity, 0% salinity, 200 µg/L, or 600 µg/L copper, and CT max was assessed. No significant differences in CT max were found in response to changes in environmental salinity or dissolved oxygen. However, control green crab exhibited a CT max of approximately 37.6 ± 0.3 °C, while copper exposed green crab exhibited significantly reduced CT max values in both the 200 µg/L (36.7 ± 0.1 °C) and 600 µg/L (36.6 ± 0.3 °C) treatments. Heart rate, metabolic rate, and copper accumulation in the heart, hemolymph, and gill are also assessed. This research offers valuable information regarding C. maenas' tolerance to environmental stress, which may play a vital role in their invasive success.

Affiliation

University of Alberta

Presentation type

Poster

Chironomid Assemblage Response to Historical DDT Applications within remote lakes from New Brunswick, Canada

Ilya Dimitrovas[1], Branaavan Sivarajah[1], Christopher Edge[1], Joshua Kurek[2]

[1]Co-author, [2]Supervisor

Between 1952 and 1968, 5.7 million kg of the organochlorine insecticide DDT was applied to ~50% of New Brunswick (NB) forests to combat outbreaks of spruce budworm (*C. fumiferana*). Through atmospheric and surface water inputs, DDT is transported to aquatic ecosystems where it can negatively impact benthic macroinvertebrate communities. To examine legacy effects of DDT, we will use sediment cores from 31 lakes to assess legacy DDT, DDD, and DDE (total DDT), as well as chironomid (midge fly) subfossil assemblages using a top-middle-bottom paleolimnological approach. Watershed delineations were made using ArcGIS and the average amount of DDT applied in each was calculated in kg/ha from digitized historical maps. Using this value, we divided these into low, medium, and high groups. Watershed area and other characteristics (e.g., land use, topography) varied between lakes, and this may influence the amount of total DDT found in lake sediment. Our next steps will involve analyzing chironomid assemblages and determining total DDTs. This data will help resolve historical discrepancies in DDT application records and determine modern DDT contamination. Chironomid response to DDT inputs may reveal how modern assemblages have been shaped by this legacy contaminant.

Affiliation

Mount Allison University

Presentation type

Poster

An Analysis of Primary Producers in Natural and Constructed Wetlands in Ottawa, Ontario

As the terrestrial landscape becomes increasingly urbanized, cities use constructed ponds to mitigate urban runoff, water pollution, and flooding. Beyond their core role of water retention, stormwater ponds in urban areas also function as sediment and nutrient catchments and create a unique habitat for both flora and fauna. In this study, the effects of water quality and land use on phytoplankton were determined in stormwater ponds (n = 15), natural reference ponds (n = 5), agriculture ponds (n =5), and managed ponds (n=5) of similar size across the greater Ottawa area. A total of 42 chemical/physical water quality variables along with phytoplankton abundance and taxonomic composition were sampled at each pond. Urban ponds held higher concentrations of potentially harmful cyanobacteria and microcysts while also containing the highest conductivity, chloride, and sodium levels. We predict that land use surrounding each pond is a significant predictor of algal assemblages. To improve pond habitats within cities, efforts should be directed at reducing the amount of impervious surface and road salt usage within catchment basins.

Affiliation

none

Presentation type

Oral

Diatom phenology in a deep, oligotrophic lake on the Canadian Shield Ontario and their application to understanding watershed and climatic influences.

Krysten Lafond[1], Kate Laird[1], Brian Cumming[1]

[1]Queen's University

Desert Lake, a deep (max depth ~68m), 382 ha cold-water lake, has a current catchment of ~76% forested shoreline with a low density of cottages and includes a large portion of Frontenac Provincial Park. Total phosphorus measurements indicate generally oligotrophic conditions since at least 1995. The limited recent disturbance in the watershed, and its importance as a naturally reproducing trout lake, led to this lake being selected for paleolimnological analysis. The preliminary paleolimnological study from Desert Lake indicated a large change in diatom assemblages ca. 1980, characterized by an increase in small centric diatoms from ~10 to over 80%. Similar findings found in many other lakes in the Northern Hemisphere have often been related to regional warming.

Warming induced changes in lakes include, reduced duration of ice cover, changes in the strength and duration of stratification and changes in the duration of spring and fall mixing, all which influence algal phenology. Analysis of the phenology of the small centric diatoms in Desert Lake, along with analysis of nutrients, chorophyll *a*, stratification and other limnological variables can provide insights into the current dominance of these taxa and changes in their overall biomass. Sampling carried out bi-weekly beginning a few days after ice off in April through fall turnover in December, provide a record of changes in diatom species composition and abundance over nearly the entire ice-free season. This high-resolution analysis of diatom seasonality will be used to help interpret the ca. 1980 change in Desert Lake and in other similar lakes.

Affiliation

Queens University, Kingston ON

Presentation type

Oral

Refining understanding of ecological thresholds and habitat vulnerability of Saskatchewan-Nelson and Western Arctic Bull Trout populations

Neil Mochnacz[1], Lee Gutowsky[1]

[1]Fisheries and Oceans Canada

Bull trout populations in the Western Arctic and Saskatchewan-Nelson regions face numerous cumulative environmental stressors. Here, we describe a comprehensive research program designed for effective population-level assessment and monitoring, understanding critical habitat thresholds, and addressing the gap in habitat vulnerability assessments for populations in these regions. The multifaceted research approach includes assessment and monitoring in key areas such as Wrigley Creek (AB) and Nahanni National Park (NWT) where eDNA and electrofishing are deployed in collaboration with Parks Canada and other agencies. This research prioritizes monitoring the ecological integrity of aquatic ecosystems while also developing occupancy-based sampling designs. Additionally, the work explores habitat and thermal thresholds, annual thermal regimes, potential local adaptation to different thermal environments, and uncovers divergent responses of bull trout populations to climate warming across a broad latitudinal gradient. We also detail experiments on acute toxicity to environmental stressors, their interactions with temperature, and physiology experiments focusing on growth, consumption, feeding efficiency, and the thermal impacts on egg development and survival.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

Mechanisms and consequences of microgeographic adaptation in Atlantic cod

Rebekah Oomen[1], Halvor Knutsen[2], Esben Moland Olsen[2], Sissel Jentoft[3], Anna Kuparinen[4], Elisabeth Juliussen[5], Mari Kawakatsu[6], Asher Leeks[7], Jack Shaw[8], Anshuman Swain[9], Bastiaan Star[3], Nils Chr. Stenseth[3], Jeffrey Hutchings[10]

[1]University of New Brunswick Saint John, [2]Institute of Marine Research Flødevigen, [3]University of Oslo, [4]University of Jyväskylä, [5]University of Agder, [6]University of Pennsylvania, [7]Yale University, [8]Santa Fe Institute, [9]Harvard University, [10]Dalhousie University

How can marine fish adapt to local environments when there is so much potential for high gene flow to erase differences among populations? And what are the consequences for how we manage these valuable natural resources? The dynamic coastal seascape of southern Norway - full of fjords and islands - presents a unique opportunity to explore the limits of local adaptation in the face of gene flow in an iconic marine fish, Atlantic cod. This talk will summarize ten years of a transatlantic collaboration between Canada and Norway to understand the drivers and consequences of cod's ability to adapt to local environmental challenges. An initial hunch that cod residing inside a fjord might harbour unique adaptations compared to cod just outside of the fjord led to the discovery of fine-scale local adaptation, genetically distinct ecotypes in secondary contact after the last ice age, and large chromosomal inversions that dominate how cod respond to their environment. Behavioural and genetic barriers to gene flow between ecotypes maintain their distinctiveness, with major consequences for the future of coastal cod in Norway. The 'fjord' cod are a dying breed, but recognition of their evolutionary distinctiveness and particular vulnerability to the large recreational fishery has led to their temporary, partial protection. Insights from this unique system are transferrable throughout the North Atlantic, as current broad-scale management regimes have proved ineffective in promoting cod population recovery in the face of intraspecific variation in cod's response to environmental challenges.

Affiliation

University of New Brunswick Saint John

Presentation type

Oral

Regional environmental genetic adaptation leads to differential climate vulnerability of two ecologically important copepods in the Northwest Atlantic

Claudio DiBacco[1], Stephane Plourde[2], Pierre Pepin[3], Catherine Johnson[1], Tony Kess[3], Meghan C. McBride[1], Ian Bradbury[3], Danielle Davenport[1]

[1] Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, Nova Scotia B2Y 4A2, Canada. , [2]Pêches et Océans Canada, Direction des Sciences océaniques et Environnementales, Institut Maurice-Lamontagne, 850 route de la Mer, C.P. 1000 Mont-Joli, QC G5H 3Z4, Canada, [3] Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada, St. John's, Newfoundland A1C 5X1, Canada

With climate change altering all aspects of marine ecosystems, actionable management strategies to preserve marine ecosystem functioning, commercial fisheries and species at risk require knowledge of how and why species may be vulnerable to future climate change. From an evolutionary perspective, populations evolve differences that provide a fitness advantage under local environmental conditions. Predictions of expected evolutionary responses to future climates via evolutionary pathways can be achieved by studying the environmental drivers of genomic variation and then incorporating genomic information into climate change impact assessments to determine genomic vulnerability. In this study, we present evidence of environmentally mediated intraspecific genetic diversity in two species of Calanus copepod; *C. finmarchicus* (N=458) and *C. hyperboreus* (N = 233), both dominant zooplankton species of the North West Atlantic (NWA), and important prey for endangered whales and commercial fish species alike. Using RADseq genotyping and population genomic analysis across a strong environmental gradient, we identify local genetic adaptation, population structure (Atlantic, Arctic and Gulf of Saint Lawrence) and predict spatiotemporal shifts in genomic vulnerability under future climate scenarios, with important implications for environmentally associated ecosystem change in the NWA.

Affiliation

Bedford Institute of Oceanography, Fisheries and Oceans Canada

Presentation type

Oral

Are legacy insecticides important “bygone” predictors of modern macroinvertebrate communities in New Brunswick rivers?

Josh Kurek[1], Jen Lento[2], Sandra Emry[3], Ilya Dimitrovas[1], Xiaotian Hua[4], Moira Ijzerman[5], Katlyn Morrow[1], Jessica Ollinik[6], Laura Schnell[6], Scott Sugden[4], Markus Thormeyer[3], Amy White[7], Karen Kidd[8], Chris Edge[9]

[1]Mount Allison University, [2]University of New Brunswick, [3]University of British Columbia, [4]McGill University, [5]University of Guelph, [6]University of Regina, [7]University of Waterloo, [8]McMaster University, [9]NRCAN

Global production and diversification of synthetic chemicals, such as pesticides, have outpaced most agents of global change since ~1970. Yet, synthetic chemicals as drivers of ecosystem change remain understudied in ecology. Do synthetic chemicals applied decades ago influence modern aquatic biodiversity? Forestry stakeholders in the Atlantic Canadian province of New Brunswick ran arguably one of the world’s largest aerial insecticide spray programs between 1952-1993 to control outbreaks of Eastern Spruce Budworm. At least one insecticide was applied to 97% of the province’s forests, including DDT which persists today as mostly DDE and DDD in soils, lakes, and biota, often at levels above national guidelines. To investigate potential legacy effects of historical insecticide applications on key lotic communities we compiled and harmonized benthic macroinvertebrate data sampled following the CABIN protocol (> 400 sites, ~60 families) and ecologically relevant data sets of predictors at the site, reach, and upstream catchment scales in dozens of 1-6 order streams and rivers. Environmental predictors included habitat, limnological measures, landscape attributes, seasonal climate, and summaries of 10 insecticides, including cumulative toxicant load. Preliminary results showed a statistically significant positive relationship between toxicant load and DDTs (DDT + DDE + DDD) from modern lake sediments. Indirect ordinations of the macroinvertebrate data showed DCA axis lengths of < 2.5 and variation explained by PC1 and PC2 at 14% and 13%, respectively. Next steps include variance partitioning and hierarchical constrained clustering to test the importance of predictors and identify where thresholds occur across the environmental gradient.

Affiliation

Mount Allison University

Presentation type

Oral

Artificial light at night alters the stress physiology of juvenile lake sturgeon (Acipenser fulvescens)

Christine Madliger[1], Steven Cooke[2], Trevor Pitcher[3]

[1]Algoma University, [2]Carleton University, [3]University of Windsor

The advent of artificial lighting constituted a new stressor for many organisms, disrupting daily and seasonal cycles with potential downstream consequences for population persistence. Both the extent and brightness of light, as well as the variety of spectra that can be transmitted, have been increasing over time. Given that organisms have inherent visual sensitivities, light sources with different spectral characteristics can disrupt physiology and behaviour to different degrees. Further, despite the high concentration of artificial light at night (ALAN) around coastlines, the consequences of light pollution have been less common in fishes compared to their terrestrial counterparts. We combined repeated measures of baseline cortisol, glucose, and hematocrit to assess the physiological response of juvenile lake sturgeon (*Acipenser fulvescens*) to ALAN over two time periods: 1 day and 1 week. We tested two lighting treatments (blue-shifted and yellow-shifted) at a brightness designed to mimic overhead lighting. While we did not find differences in baseline cortisol levels between groups exposed to different spectral compositions of light, baseline cortisol levels were significantly higher under lit conditions compared to a dark control. We did not find any differences between groups in hematocrit or glucose levels. Our results indicate that exposure to ALAN of multiple spectral compositions can influence the baseline stress physiology of sturgeon. The conservation of the juvenile life stage of lake sturgeon is an important consideration for the overall management of this species, and investigations that contribute to a broader understanding of their stressor landscape can support this overarching goal.

Affiliation

Algoma University

Presentation type

Oral

The role of chromosomal inversions for environmental adaptation in Atlantic cod

Rebekah Oomen[1], Rebecca Krohman[1]

[1]University of New Brunswick

Due to rising ocean temperatures in the Arctic, Arctic ice is melting at an increased rate. Ocean currents move the melting glacier water from the Arctic into the Northern Atlantic Ocean. This water is fresher and colder than the seawater Atlantic marine animals are adapted to, which might stress the animals. Atlantic cod is an ecologically and culturally important species and is endangered due to previous overfishing. Understanding the biology of cod is essential for informing management strategies to increase its population size. Chromosomal inversions on linkage groups 1, 2, 7, and 12 are present in different frequencies across the Atlantic Ocean, linked to salinity, oxygen, and temperature gradients. Chromosomal inversions may be important for local adaptation to environmental stressors because they can prevent locally adapted genes from being separated through recombination. Therefore, inversions in cod may influence adaptation to salinity and temperature stress but common garden experiments are needed to confirm this. Discovering how cod genotype frequencies change when exposed to stressors is informative for their conservation and management in the face of global change. This poster will outline the current knowledge of inversions in Atlantic cod and propose an experiment that will further the knowledge of the role of inversions in adaptation to environmental stressors. The experiment will determine how inversion genotype frequencies change when the early life stages of cod are exposed to thermal and salinity stress applied separately and together.

Affiliation

University of New Brunswick

Presentation type

Poster

Can Local Management of American Eel Succeed?

Marten Koops[1], Madison Brook[1], Adam van der Lee[1]

[1]Fisheries and Oceans Canada

American eel (*Anguilla rostrata*) is a panmictic, catadromous species distributed along the Atlantic coast of the Americas from Greenland to northern South America. The life cycle is completed through spawning in the Sargasso Sea with elvers colonizing continental habitats; in Canada, eel migration extends as far inland as Lake Ontario. This biological and spatial complexity has created challenges for assessment, management, and recovery. American eel were assessed as Threatened, with hydroelectric turbines, habitat loss, and fishing as the principal threats. American eel has not been listed; fisheries on multiple life stages continue. Both threats and fisheries have been managed at a local level. To examine the potential for this approach to succeed, we describe a Canada-wide trend in American eel abundance, identify life-history-based local mortality reference points, and evaluate the panmictic population consequences of local management strategies. Through an analysis of fishery-independent datasets, we describe a Canada-wide trajectory showing that while American Eel abundances in Canada have been stable over the last two decades, significant declines preceded this time period and were not limited to the St. Lawrence basin. From population models we describe relationships to predict mortality reference points based on local life history characteristics. Finally, we use a meta-population model to examine potential panmictic population responses to locally-based management.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

Plastic debris baseline studies in the Bay Islands National Marine Park of Honduras

The Bay Islands National Marine Park (BINMP) is situated in the Gulf of Honduras, approximately 30 miles away from the northern coast of Honduras. It is known for its ecological, commercial, and touristic significance due to the coral reef ecosystem, which is part of the Mesoamerican Reef barrier - the second-largest coral reef in the world. In 2012, approximately 12.4 million people lived in the coastal areas and watersheds that flow into the Gulf of Honduras, with each person producing between 0.5-1 kg of solid waste per day. Furthermore, studies from 2014-2019, show that around 8,000 tonnes of plastic debris entered the Gulf of Honduras via the Motagua River in Guatemala and various rivers in Honduras, including Ulua, Cangrejal, Tinto, Aguan, Sico, Chamelecon, Lean, and Cuero. This is a growing concern because plastic waste poses a threat to both the environment and human health. Despite the clear and constant plastic pollution in the area, very few studies have focused on plastic pollution in the Gulf of Honduras. This study aims to improve our understanding of plastic debris transport in the Gulf of Honduras and establish baseline studies on microplastic concentrations in marine and coastal ecosystems of the BINMP.

Affiliation

Carleton University

Presentation type

Poster

Using Etuaptmumk (Two-Eyed Seeing) to understand movements of striped bass in the Bras d'Or Lake

Caitlin Bate[1], Shelley Denny[2], Robert Lennox[1], Skyler Jeddore[2], Sara Iverson[1]

[1]Dalhousie University, [2]Unama'ki Institute of Natural Resources

Building on the talk titled "Apoqnmatulti'k: Collaborative research for aquatic stewardship", this presentation will delve into the western scientific approach of acoustic telemetry and how it is being paired with Mi'kmaw and local knowledge to better understand valued aquatic species. A growing scientific field, acoustic telemetry can be widely utilized to answer ecological questions regarding aquatic animal movements, habitat use, and life-history, with powerful applications for management and conservation. This presentation will highlight how Etuaptmumk (Two-Eyed Seeing) is guiding research concerning the movements of ji'kaw (striped bass) in Pitu'pa'q, Unama'ki (Bras d'Or Lake, Cape Breton). Ji'kaw are a culturally important species to the Mi'kmaq, a target of recreational fisheries, and listed as Special Concern in Canada (Southern Gulf of St. Lawrence population). Ji'kaw are active during the summer in the lake and overwinter from November to May, during which time they form dense aggregations and are vulnerable to predation, exploitation, and alterations of habitat. The winter ecology of ji'kaw remains a poorly understood component of their life-history, in part due to the complexity and diversity of their migratory behaviours. Starting in 2024, acoustic tagging activities will begin to help fill such information gaps. The study design is being co-developed with Mi'kmaw partners to reflect Mi'kmaw knowledge and values. This research will build upon Mi'kmaw and western understandings of seasonal movements of ji'kaw with a goal of informing shared stewardship of ji'kaw in Pitu'pa'q.

Affiliation

Dalhousie University

Presentation type

Oral

Assessment of thermal refuge enhancement success for Atlantic Salmon

Véronique Simard[1], Normand Bergeron[1], Emmanuelle Chrétien[2], Carole-Anne Gillis[3]

[1]INRS, [2]UQAR, [3]GINU

The abundance of Atlantic salmon has declined in recent decades due to threats to its habitat. In particular, the warming of rivers in eastern Canada, in the south of the Atlantic salmon range, negatively affects Atlantic salmon populations in critical phases of their life cycle, notably by influencing rates of growth and survival of juveniles. Thermal refuges are therefore essential components to the resilience of Atlantic salmon populations in eastern Canada, where episodes of thermal stress are increasing in frequency and magnitude. With that in mind, the general objective of the project is to assess the importance of cold-water refuges for juvenile Atlantic salmon. To do this, various field studies will be conducted in refuges targeted by restoration efforts, before and after the restoration work, to quantify their physical characteristics and their importance for Atlantic salmon. The study of physical characteristics includes the surface area, depth, temperature, and temporal stability of the refuge. To assess the importance of cold-water refuges for Atlantic salmon, the frequency and duration of thermal refuge use, temperature experienced by fish, as well as in situ metabolic rates will be quantified, before and after restoration. Evaluating the effectiveness of restored thermal refugia and the bioenergetic benefits to juvenile Atlantic salmon using them is necessary to better target future conservation efforts.

Affiliation

INRS

Presentation type

Oral

Effect of thermal stress on Atlantic salmon returns in Eastern Canada

Mazzei Renata[1], Emmanuelle Chrétien[2], Normand Bergeron[1]

[1]Institut national de la recherche scientifique, [2]Université du Québec à Rimouski

The warming of rivers throughout Eastern Canada poses a targeted threat to Atlantic salmon populations on the southern edge of the species distribution, where thermal stress events are increasing in frequency and magnitude. Here we investigated the potential effects of thermal stress on adult salmon returns across rivers in Eastern Canada. We used historical data on salmon returns and daily summer temperature to explore how much of the variation is explained by different thermal stress metrics, after correcting for river area and other potential confounding variables. Our first analyses indicate that maximum daily temperature explains some variation in adult salmon returns in 14 rivers of Quebec. Further analyses will include other rivers in Eastern Canada as well as other thermal stress metrics. This research will help disentangle the effects of thermal stress at different life stages of the Atlantic salmon and provide better decision tools for the management of Atlantic salmon populations in Eastern Canada.

Affiliation

Université du Québec à Rimouski

Presentation type

Oral

Microplastic export from agriculture fields to as a potential source of contamination to surface waters.

Branaavan Sivarajah[1], Jesse Vermaire[1], David Lapins[2], Jennifer Provensher[3], Nathalie Ouellette[1]

[1]Carleton University, [2]Agriculture and Agri-Food, [3]Climate Change Canada

Plastics eventually decompose into extremely small fragments (5mm or less) referred to as microplastics. Biosolids from wastewater treatment plants are a concentrated source of microplastics containing hundreds of microplastic pieces per gram dry weight. Field application of biosolids could be a potential source of microplastics to surface waters in agricultural landscapes, however, little data exists on the potential export of microplastics from these systems. We present data on microplastic concentration and composition for an experimental biosolid application to an agriculture field in Winchester, Ontario. Preliminary results indicate that biosolid application greatly increased microplastic concentrations within the soil but within a few months microplastic concentrations had declined to near background level suggesting export of microplastics to the environment. Future work will quantify this rate of export to better understand the movement of microplastics in agricultural landscapes.

Affiliation

Carleton University, Agriculture and Agri-Food, Climate Change Canada

Presentation type

Poster

A comparison of physiological responses to road salt in both a captive and wild population of Redside dace

Olivia Galloway[1], Christine Madliger [2], Trevor Pitcher[1]

[1]University of Windsor, [2]Algoma University

The Redside dace (*Clinostomus elongatus*) is federally listed as endangered in Canada and is experiencing drastic population declines. Its Canadian range is limited to Ontario, with much of the population concentrated in the Greater Toronto Area. Redside dace are particularly vulnerable to poor water quality, a phenomenon exacerbated by urbanization. Urbanization has impacted water quality for Redside dace in many ways, including substantial increases in chloride concentrations in streams and rivers year-round due to road salt runoff in the winter and spring, which may detrimentally affect remnant populations. In this study we measured the behavioural (group cohesion) and physiological response (CTmax) of Redside dace in relation to an acute exposure to chloride concentrations that were ecologically relevant (0, 640, and 1000 mg/L). My presentation, however, will focus on the physiological aspect of this study (CTmax). We conducted this experiment using both a long-term captive group (kept in captivity over 2 years) as well as a group collected directly from the wild to determine whether captive laboratory populations provide reliable data that can be extrapolated to wild populations. We tested the hypothesis that acute salt exposure will significantly affect the thermal tolerance of Redside dace and predicted that exposure to higher chloride concentrations will lower thermal tolerance. This work will inform road salt management policies as well as reintroduction programs for at-risk freshwater fishes.

Affiliation

University of Windsor

Presentation type

Poster

A Global Systematic Scoping Review of Environmental and Cultural Flows Adoption in Watershed Governance Contexts

Nathanael Bergbusch[1], Simon Courtenay[1]

[1]University of Waterloo

This study systematically reviews the adoption of environmental and cultural flows in global water governance. Through mixed-methods analyses, we illustrate that 39 countries do, or describe how they could, manage environmental flows, with greater representation by Australia and the United States, and attention to cultural flows in Australia, India, Canada, Mexico, and New Zealand. In 88 watersheds surveyed, there was state-based, co-governance, polycentric, and public-private arrangements. Evaluated against the OECD Water Governance Framework, we found that generally there is consideration of appropriate scales, adaptive capacity, and engagement in the operationalization of environmental flows but limited consideration of roles in policymaking. However, in cases where non-state-based governance arrangements, cultural flows, and combined attention to environmental and cultural flows are considered there is generally more effort to strive towards OECD principles like policy coordination, regulatory frameworks, innovative practices, and financing water programs. In these instances, environmental and cultural flows are considered more than a technical process to communicate hydro-social-ecological information to decision-makers but rather an opportunity to create a collaborative water development space, spontaneous collaborations during hydrologic extremes, linkages between spatial and institutional scales, water justice to rebalance power, and conditions under which water is reserved for the environment, people, and rights in water markets. Overall, there appears to be a greater investigation of countries' governance of environmental and cultural flows in the last decade, but we identify a need for attention to policy coordination and an evaluation of regulatory frameworks and environmental impact assessments in which water-related development decisions are made.

Affiliation

University of Waterloo

Presentation type

Oral

GHG EMISSIONS FROM THE PAIX DES BRAVES (EASTMAIN-1) RESERVOIR 17 YEARS AFTER FLOODING, QUÉBEC (CANADA)

Alain Tremblay[1], Maud Demarty[2], Charles Deblois[2], Paul del Giorgio[3], Francois Bilodeau[1], Yann Chavaillaz[1]

[1]Hydro-Québec, [2]Aqua-Consult, [3]UQAM

Hydropower represents 15.8 % of the total electricity production worldwide and is considered as a key to meeting the increasing demand in low carbon energy in the context of climate change. Reservoirs greenhouse gas emissions are thus on the radar of energy sector stakeholders and policy makers. Models are often useful to simulate the ecological footprint of future hydropower developments in term of GHG emissions, but their conception is challenging because of the lack of *in situ* long-term datasets used to calibrate them. This study examines the spatial and temporal variability in CO_2 and CH_4 dissolved concentrations in the Paix des Braves boreal reservoir over a 17-year period, with an emphasis on the reliability of automated systems (SAGES) that are installed in generating stations and are specially designed to facilitate affordable and long-term monitoring all year round. Diffusive, downstream and ebullitive CO_2 and CH_4 emissions were considered in the analysis. CH_4 emissions represented only 1 % to 6 % of the total gross emissions, and CO_2 diffusive emissions represented 80 % to 90 % of the total emissions in CO_2-equivalent. The results confirm the decreasing trend in dissolved CO_2 a few years after flooding unlike what is observed for CH4 concentrations due to their high variability. Seasonal variability is described based on daily measurements gathered with the SAGES. Net emissions measured 15 years after impoundment are similar to values predicted by empirical model based on the measurements made right after impoundment.

Affiliation

Hydro-Québec

Presentation type

Oral

Circumpolar assessment of freshwater biodiversity highlights the need for improved coordination of biodiversity monitoring in the Arctic

Jennifer Lento[1], Willem Goedkoop[2], Joseph Culp[3]

[1]Canadian Rivers Institute and Department of Biology, University of New Brunswick, [2]Department of Aquatic Sciences and Assessment, Swedish University of Agricultural Sciences, [3]Wilfrid Laurier University Cold Regions Research Centre and Department of Biology, University of New Brunswick

The freshwater group of the Circumpolar Biodiversity Monitoring Program (CBMP-Freshwater) conducted the first circumpolar assessment of status and trends in Arctic freshwater biodiversity. Working with scientists from all Arctic countries, the CBMP-Freshwater created a database of biodiversity data and supporting abiotic data for lakes and rivers from across the circumpolar region and assessed spatial and temporal trends of alpha and beta diversity to establish a baseline upon which future monitoring efforts can be built. The circumpolar assessments for benthic diatoms, macrophytes, plankton, benthic macroinvertebrates and fish provide novel analyses of how climate change and associated environmental drivers, particularly temperature and geographic disconnection, affect the biodiversity of these organism groups. These assessments also highlighted the gaps in our knowledge and a need for greater coordination and harmonization in monitoring biodiversity. Spatial gaps in biodiversity data and a lack of routine (temporally replicated) monitoring were most evident in non-European countries due to the difficulties accessing Arctic regions and the lack of regulations mandating regular monitoring and reporting. In this presentation, we synthesize the knowledge on alpha and beta diversity in Arctic freshwaters gained from the regional and circumpolar assessments, and summarize the major environmental correlates of biodiversity patterns and predicted drivers of change. As a way forward, we discuss the need for development of coordinated and harmonized long-term circumpolar freshwater monitoring, including the use of new technologies and development of community-based monitoring networks, to build a framework for science communication and decision support.

Affiliation

Canadian Rivers Institute and University of New Brunswick

Presentation type

Oral

SINEs for the times: targeting short interspersed nuclear elements as eDNA markers increases ability to detect a rare species and provides insights to genetic diversity

Samantha Beal[1], Beth Watson[1], Ian Paterson[1], Jeremy Broome[2], Ian Bradbury[3], Paul Bentzen[1]

[1]Department of Biology, Dalhousie University, Halifax, NS, [2]Department of Fisheries and Oceans Canada, Dartmouth, NS, [3]Department of Fisheries and Oceans Canada, St. John's, NL

Environmental (e)DNA has become a well-established aquatic biodiversity monitoring tool, however most studies to date have focused on targeting mitochondrial markers. Here, the ability to detect endangered Atlantic Whitefish using an eDNA marker targeting a nuclear SINE sequence, *Sma*I-corII, was compared to a marker targeting a mitochondrial ND4 sequence. Within a net pen housing juvenile Atlantic Whitefish and suspended in a lake, the abundance of SINE copies was roughly 100 times greater than ND4. Outside of the net pen, the maximum distance of detection of the ND4 marker was approximately 20 m while the SINE marker had detections up to 80 m, the maximum distance tested. Genetic diversity within the *Sma*I-corII SINEs was assessed in 16 Atlantic Whitefish individuals. Six amplicon sequence variants (ASVs) were detected, five of which were present in all individuals. One of the five ubiquitous ASVs was identical to the *Sma*I-corII consensus sequence and was the most abundant ASV in all individuals. One ASV was detected in a single individual and comprised 3.84% of its read depth. Analysis of eDNA samples containing Atlantic Whitefish DNA detected the five ubiquitous ASVs. Amplification of *Sma*I-corII sequences from eDNA samples obtained from a lake in which Lake Whitefish occur detected six ASVs, four of which, including the *Sma*I-corII consensus sequence, were shared with Atlantic Whitefish, and two of which were unique to Lake Whitefish. These results indicate SINEs are sensitive eDNA markers and can be used to detect genetic diversity via eDNA analysis.

Affiliation

Dalhousie University

Presentation type

Oral

Wolastoq Watershed Management Process

The Wolastoq is one of the longest rivers in North America and is rich in biodiversity. The river provides spawning and rearing habitat for many commercially viable fish and other invertebrates. Certain areas of the river have already been identified as critical habitats for several endangered and threatened fish, invertebrates, etc. listed under SARA. Thousands of people who live on the banks of Wolastoq have been using the river as the major drinking water source. The river is used for recreation which is under enormous pressure due to industrial and anthropogenic activities. These activities input sediment, nutrients, metals, chemicals, bacteria, and oxygen-consuming wastes into the river. The result will be a reduction in the river's ability to support fish and other aquatic life or to be used for drinking water or recreation. MNCC has been running a transboundary process to formulate a management strategy for the Wolastoq since 2004 in collaboration with the rights and stakeholders of the river in Canada and the United States (US). We have so far conducted more than 5 transboundary summits and recently the process was officially recognized by federal agencies in Canada and the US. During the transboundary summit held in Madawaska (2017), an "Interim Statement of Cooperation" was signed between US federal agencies, Canadian federal departments, and Maliseet First Nations in the US and Canada. This is a living process and the current focus has been on the fish passage barriers, pollution, and the impact of climate change on biodiversity in the river.

Affiliation

Maliseet Nation Conservation Council

Presentation type

Oral

Evaluating strategies for mitigating the effects of transport stress in reintroduced Atlantic Salmon (Salmo salar)

Dane Roberts[1], Christine Madliger[2], Trevor Pitcher[1]

[1]University of Windsor, [2]Algoma University

Transport is an unavoidable stressor for reintroduction efforts. We evaluated the effectiveness of (1) pre-transport enrichment and (2) post-transport release strategy on the mitigation of transport induced stress in reintroduced hatchery-reared juvenile Atlantic salmon (*Salmo salar*). First, we compared probiotic diet supplementation and structural enrichment versus controls (conventional rearing tanks) as pre-transport enrichment strategies that may reduce the stress response of fish to transport. The physiological response (using cortisol, glucose, and lactate as proxies) of enriched fish was compared to that of non-enriched (control) fish following transport. Second, for post-transport stress mitigation, we compared the standard hard-release method (immediate release after transport with no acclimatization period) to a soft-release method (2 & 4 days in-stream acclimatization prior to release). Following a transport event, hard release fish were immediately assessed for their physiological response. Soft-release fish were assessed for their physiological response but following 2 and 4 days of in-stream acclimatization. Our findings will inform transport strategies for reintroduction efforts.

Affiliation

University of Windsor

Presentation type

Oral

GHG Program at Hydro-Québec: A focus on the use of automated GHG measuring systems in generating stations to capture temporal variations of the carbon footprint of reservoirs

Yann Chavaillaz[1], Charles Deblois[2], Maud Demarty[2], François Bilodeau[1], Maude Larochelle[1], Alain Tremblay[1]

[1]Hydro-Québec, [2]Aqua-Consult

Hydro-Québec is the largest electric power company in North America and one of the world's leading producers of hydropower. Hydroelectric reservoirs temporarily generate more greenhouse gases (GHGs) than the natural environments they replace. It is therefore important to measure GHGs to monitor the extent of the environmental impacts of hydroelectric power generation. While the accuracy and robustness of GHG emissions measurement and modelling has improved substantially, there are obstacles to the development of an efficient measurement network that adequately covers the entire territory and has the capacity to report emissions for all Hydro-Québec facilities in a representative way. With that in mind, an automated system (SAGES) that measures the GHG emissions of discharged reservoir water was developed. SAGES are gradually being installed in Hydro-Québec generating stations. Because they measure GHG concentrations in water throughout the year, require simple and minimal maintenance, and may be easily deployed, SAGES constitute an excellent means to compare the GHG emissions from our reservoirs with flux measurements directly on their surface. Here we present results on several reservoirs and especially on the Paix-des-Braves reservoir and on the Romaine-2 reservoir, for which we have 17 and 7 years of data, respectively. These substantial timeseries will enable us to validate model predictions, to extrapolate results on other reservoirs, and to better assess the emissions generated from Québec hydropower.

Affiliation

Hydro-Québec

Presentation type

Oral

Characterization of Lake Trophic Status and Cyanobacteria Presence in Kejimkujik National Park

Sarah Macdonald[1], Rob Jamieson[1], Lindsay Johnston[1], Yannan Huang[1], Hannah Morris[1], Lydia Zamlynny[1], Natalie Thimot[2], Daniel Beach[3]

[1]Dalhousie University, [2]Parks Canada, [3]National Research Council

Kejimkujik National Park and National Historic Site (Nova Scotia, Canada) is home to numerous lakes that support a multitude of recreational activities and aquatic habitats. The park is comprised of camp sites, canoeing routes, and hiking trails, making it a popular tourist attraction during the summer months. Aquatic systems in the park also support diverse assemblages of organisms. The next-generation MiSeq illumina sequencing results indicate that cyanobacteria are present in recent samples taken from lakes within the park, but little is known about whether these photosynthetic bacteria populations could proliferate and form harmful blooms. Several factors may contribute to the proliferation of cyanobacteria, including nutrient abundance, light availability, water temperature, mixing regimes, and flushing rates. The objective of this study is to identify lakes within the park that are susceptible to cyanobacterial blooms. This involved a vulnerability assessment, using publicly available spatial and water quality data, to characterize the lakes in Kejimkujik National Park in the context of factors known to contribute to harmful cyanobacterial blooms. The results of this assessment will be compared to the information collected from a park-wide cyanobacteria sampling program and toxin survey conducted in 2023 to assess the applicability of this screening approach for identifying lakes vulnerable to blooms.

Affiliation

Dalhousie University

Presentation type

Poster

Brook trout (Salvelinus fontinalis) as a model anadromous species to evaluate water withdrawal effects in a groundwater-driven coastal watershed.

Bruno Mendonca[1], Andre St-Hilaire[2], Michael Van Den Heuvel[1]

[1]UPEI, [2]INRS

This research emphasizes the role of biological validation when formulating Environmental Flows guidelines. It centers on a small-scale watershed (Coles-creek), part of the North River, in Prince Edward Island (Canada). This watershed is primarily influenced by groundwater inflow and subjected to water abstraction pressures, resulting in low flow and elevated temperatures. The study spans eight years, from 2016 to 2023, monitoring the pre- and post-water pumping periods. A comparative analysis was conducted between different sections of the same stream and with a paired reference stream unaffected by water abstraction, in which we examined the impact on local brook trout (*Salvenilus fontinalis*) populations. A pronounced reduction in summer stream flow was observed, surpassing recognized low flow thresholds for water abstraction. Temperature consistently exceeded the optimal growth thresholds for the brook trout, eventually reaching levels of physiological stress. A substantial reduction in the length of the brook trout Young of the Year (YOY) coincided with the years 2020 and 2022, the lowest summer flows observed here. This evidence of potential stress was attributed to low flow and elevated temperature conditions. However, the relationship between environmental variables and the brook trout population's density or biomass was unclear. Thus, at this stage, the seasonality effect must be considered since the complete growth period of brook trout influences the observed YOY growth trends. It is essential to recognize the potential influence of other stress factors associated with low flow and high temperatures, including stream habitat loss, stream productivity, land use, and climate change effects.

Affiliation

UPEI

Presentation type

Oral

Metal toxicity to a sensitive freshwater snail: effects of temperature and diet

Anne Crémazy[1], Megan Mattsson[2], Mariem Fadhlaoui[1], Isabelle Lavoie[1], Antoine Faure[1], Léna Guimard[1]

[1]Institut National de la Recherche Scientifique, [2]University of New Brunswick

It is known that temperature can have important effects on the toxicity of metals to aquatic organisms. Yet, there is a data gap on thermal effects on chronic metal toxicity to sensitive organisms. This must be addressed, as increased global temperature and heat waves frequency are occurring as a result of climate change. In addition, there has been doubts on the validity of some metal toxicity studies conducted with the metal-sensitive freshwater snail *Lymnaea stagnalis*, on the basis that snails may not always be tested using suitable diet. In the laboratory, we investigated temperature and diet quality effects on chronic metal (nickel et copper) bioaccumulation and toxicity to *L. stagnalis*. We found that temperature and Ni separately had strong effects on juvenile growth rate and survival. Rising temperature from 18 to 26 °C had no noticeable effect on Ni-induced growth inhibition, but appeared to exacerbate Ni lethality to juvenile snails. This exacerbation might have been due to a combination of factors, including detrimental changes in metabolically available Ni pools and/or to sensitization of the organism under sub-optimal temperatures. We found that diet and Cu separately had strong effects on juvenile growth rate. We are currently assessing the impacts of diet on Cu sensitivity to these snails.

Affiliation

Institut National de la Recherche Scientifique et Institut Canadien des Rivières

Presentation type

Oral

Participatory mapping for fish habitats and Cree people in Eeyou Istchee

Adriana R Aguilar-Melo[1], Kathleen Church[1], Anna Krupa[2], Graeme Morin[2], Thomas Stevens[3], Hugo Asselin[4], Katrine Turgeon[1]

[1]Université du Québec en Outaouais, [2]Cree Nation Government, [3]Cree Trappers' Association, [4]Université du Québec en Abitibi-Temiscamingue

In Eeyou Istchee (northern Quebec), fish habitats are integral parts of the landscape and of the Cree people's wellbeing and cultural history. However, fish habitats in this region are under development pressure, notably for hydropower, forestry and mining. A solution for conserving fish and fish habitats, while also allowing reasonable development, is through fish habitat compensation and habitat banking (a way to compensate before development occurs using credit habitats). The effectiveness of fish habitat compensations and banking habitats as a conservation tool is the subject of debate among scientists. With this research project, we aim to combine Cree Traditional Ecological Knowledge (TEK) and Scientific Ecological Knowledge (SEK) to inform planning and decision-making for fish habitat compensation and fish habitat banking in Eeyou Istchee. Our objectives are to build on participatory mapping exercises with Cree tallymen and land users, and to identify habitats of concern with either high or low potential for compensation or banking projects. For each location we consider their geophysical characteristics, bioecological variables, the presence and type of prior or current development projects, the degree of access to fish habitat, the traditional use of the fish habitat, and the TEK of the Cree land users. This exercise will then be used to co-develop a planning tool for the Cree for future fish habitat compensation and banking projects that more effectively balance both conservation and industrial development.

Affiliation

Université du Québec en Outaouais

Presentation type

Oral

Assessing habitat provisioning services for aerial insectivores from urban floodplain wetlands

Thamarasi Aththanayaka[1], Mehrdad Hajibabaei[2], Brian Hayden[1], Gregory Mitchell[3], Michael Wright[2], Donald Baird[4]

[1]Department of Biology, University of New Brunswick, [2]Centre for Biodiversity Genomics, University of Guelph, [3]Wildlife Research Division, Environment & Climate Change Canada, [4]Environment & Climate Change Canada@ Canadian River Institute, Department of Biology, University of New Brunswick

Urban wetlands play a pivotal role in providing a range of ecosystem services, with a particular focus on habitat provisioning through secondary production. These wetlands offer a crucial source of nutrition enriched with highly unsaturated fatty acids, primarily in the form of emerging aquatic insects, which support the dietary needs of aerial insectivores (birds and bats). It is plausible that these species rely on habitat cues provided by these wetlands when selecting breeding areas in spring. However, the sustainability and efficacy of these provisioning services are threatened by contamination resulting from increasing human pressures on urban wetlands, particularly where wetlands are situated on former landfill or other contaminated habitat. This prompts the need to investigate how differing levels of contamination influence the habitat preferences of insectivore birds and bats (richness).

In our study, we studied seven urban floodplain wetlands in the Wolastoq|Saint John River located within the Fredericton city limits. Our research focused on assessing baseline condition within these wetlands with respect to contamination levels, the quantity of emerging aquatic insect biomass, their fatty acid profiles, adjacent bird and bat richness and the isotopic signature of the benthic macroinvertebrate community. Our key question is: do these urban wetlands provide beneficial habitat for wildlife or do they function as ecological traps? By examining the interplay between contamination levels and food provisioning services, our research aims to shed light on the intricate dynamics of urban wetland ecosystems and their associated aquatic/terrestrial food web linkages.

Affiliation

PhD Student- University of New Brunswick

Presentation type

Oral

Studying fish in collaboration with Inuit fishers

Véronique Dubos[1]

[1]Université Laval

Presentation of two case studies, one in Nunavik and one in Nunavut, conducted in collaboration with Inuit communities to study fish species of interest and some specific concerns they have.

Arctic char is an important traditional and subsistence species for Inuit populations. In Kangirsuk (Nunavik, QC), fishers have observed a decrease of Arctic char populations. They are also concerned about potential overfishing and environmental modifications. The local association of hunters (Anguvigapik) is leading a study to set a reference state of the local Arctic char population. One of the goal was understanding where the char overwinter in a close lake. We used acoustic telemetry to elucidate this question and it highlighted the factors triggering the downstream migration. These results, combined with the Inuit knowledge of the fish migration route and environmental modifications will allow the Anguvigapik to manage the community subsistence fisheries.

In the High Arctic community of Cambridge Bay (NU), the local Hunters' association (EHTO) and Fisheries and Oceans Canada collaborate on a long-term project to monitor fish populations. The EHTO has raised concerns about the significant increase in commercial shipping traffic. Indeed, with global warming and the increasing accessibility of the Northwest Passage, the community finds itself on a cruise tourism route, with 13 visiting cruise ships, last summer of 2023. A fine-scale telemetry project is ongoing to study the impact of cruise ships on the fish movements for other locally important subsistence fish for the community, Greenland cods and sculpins, that are considered sedentary in the bay.

Affiliation

Université Laval

Presentation type

Oral

Connecting people and ecosystems: Developing a holistic environmental flows framework for the Wolastoq

Wendy Monk[1], Jennifer Lento[2], Roxanne MacKinnon[3], Jamylynn McDonald[3], Gillian Kerr[4], Molly Demma[4]

[1]Environment and Climate Change Canada @ Canadian Rivers Institute, Faculty of Forestry and Environmental Management, University of New Brunswick, [2]Canadian Rivers Institute and University of New Brunswick, [3]ACAP Saint John, [4]St. John River Society

Flow modification, including changes to timing and magnitude of flows, has been identified as one of the major concerns for freshwater ecosystems because of increased fragmentation and shifts in ecosystem structure and function. Such changes to freshwater ecosystems have the potential to impact ecosystem health and disrupt the social and cultural benefits that humans derive from freshwater resources. Environmental flow frameworks seek to identify the flow conditions required to support healthy ecosystems while maintaining social and cultural connections. However, these frameworks require a strong understanding of flow-ecology relationships and ecosystem-derived benefits. The Mactaquac Aquatic Ecosystem Study initiated development of an environmental flows framework for the Wolastoq through engagement with freshwater experts and local communities. Experts designed 69 testable flow-ecology hypotheses for the Wolastoq, describing mechanistic linkages between different forms of flow alteration and structural and functional changes to river and floodplain ecosystems and communities. A public survey was conducted to support these linkages by gathering information about how local communities engage with and value the river, and identifying their primary concerns. Survey responses were grouped by environmental tastes, which describe the key social, cultural, and economic benefits derived from the river. Environmental tastes were linked to respondents' concerns to generate a better understanding of how interactions with the river influence a person's views of issues related to the river. Through consideration of the potential impacts of flow alteration on both ecosystem function and ecosystem-derived benefits, this work is intended to support a more effective environmental flow framework for the Wolastoq.

Affiliation

Canadian Rivers Institute and University of New Brunswick

Presentation type

Oral

A simulation-based comparison of confidence interval coverage, bias, and variance of biomass estimates for alternative spatial models used for the evaluation of Northern Shrimp.

John-Philip Williams[1], Eric Pedersen[1]

[1]Concordia University

In fisheries management, reliable estimates are crucial for sustainability and balanced decision-making. The OGive MAPping (OGMAP) method, used by the Department of Fisheries and Oceans in Newfoundland for population parameter estimation, addresses non-normally distributed populations but raises concerns about handling spatial data variations. To assess OGMAP, we conducted a simulation-based comparative analysis against Generalized Additive Models (GAMs) and STRAtified Programs (STRAP). Our question: Is the uncertainty of the estimates reliable?

Using the Northern Shrimp, *Pandalus Borealis*, as a reference, we simulated biomass landscapes, exploring parameters like landscape roughness, sampling intensity, and model settings. The analysis consistently showed OGMAP's failure to capture nominal confidence intervals (CIs) compared to alternatives, regardless of the treatment. OGMAP exhibited tighter intervals, raising concerns about overfitting and its inability to reflect the true landscape biomass. However, halving the automatically optimized bandwidths for OGMAP's probability distribution fields significantly improved its realized coverage.

Our findings underscore OGMAP's variability, shedding light on its limitations in decision-making by the Department of Fisheries and Oceans. We stress the pivotal role of reliable estimates in fisheries management. Additionally, our study suggests that alternative methods, like GAMs, may offer more dependable forecasts given OGMAP's underperformance. This research prompts a review of the fisheries management framework relying on OGMAP, suggesting potential inadequacies in capturing the true uncertainty associated with spatially distributed stocks.

Affiliation

Concordia University

Presentation type

Oral

Assessing the causes of Atlantic salmon declines in eastern Cape Breton and the efficacy of smolt-to-adult supplementation for the restoration of endangered populations.

Natalie Koopman[1], Glenn Crossin[1], Robert Lennox [1], Sarah Penney[2], John Batt[1], Michael Martino[1]

[1]Dalhousie University, [2]Parks Canada

Robust and healthy Atlantic salmon (*Salmo salar*) populations are integral to Canada's ecology, economy, and culture. However, Atlantic salmon are threatened throughout their range by climate change, habitat degradation, and declining marine habitat quality. Located in Highlands National Park in eastern Cape Breton, the Clyburn Brook has been monitored by Parks Canada for over 30 years, which has revealed a dramatic 95% decline in the Atlantic salmon population. The Eastern Cape Breton Atlantic salmon designatable unit is listed as Endangered (COSEWIC) due to the imminent extirpation of many populations, including the Clyburn Brook. In collaboration with Parks Canada, the spatiotemporal patterns of the Clyburn Brook's Atlantic salmon population will be explored by examining the efficacy of smolt-to-adult supplementation (SAS). Over the last 3 years, the SAS approach has been used as an emergency recovery strategy, in which wild smolts are transported to the Aquatron at Dalhousie University for 1-2 years and grown to adulthood and sexual maturity. The adults are then returned to the river in hopes of spawning, having bypassed the perilous first marine phase of their life history. However, there has been no formal assessment of the survival, behaviour, or reproductive activity of these supplemented salmon. Using acoustic telemetry, we compare the survivorship and behaviour of the supplemented salmon to their wild counterparts from other local rivers. Findings will contribute to Parks Canada's recovery strategy for the Clyburn Brook Atlantic salmon population and help to identify potential emergency recovery strategies to turn the tide for imperiled salmon populations.

Affiliation

Dalhousie University

Presentation type

Oral

Mixed-stock analysis of lake-migratory brook trout in an Indigenous-stewarded northern fishery

Badrouyk Chamlian[1], Hyung-Bae Jeon[1], Hari Won[1], Sozos Michaelides[1], Pamela MacLeod[2], Hubert Petawabano[2], Dylan Fraser[1]

[1]Department of Biology, Concordia University, 7141 Sherbrooke St. West, Montreal, QC, H4B 1R6, Canada, [2]Cree Nation of Mistissini

Effective fishery management relies on knowing the relative contributions of genetically distinct populations to mixed-stock harvests. Such knowledge is especially important for Indigenous communities that rely on commercial, recreational, and subsistence (CRS) fisheries but do not benefit from cutting-edge genomic tools to facilitate sustainable management practices. We investigated harvest contributions of 5 source populations of lake-migratory brook trout in three lakes that support fisheries important to the Cree Nation of Mistissini in Quebec: Mistassini (Quebec's largest natural lake), Mistasiniishish, and Waconichi Lakes. Together with local partners we collected a total of 1066 samples from known spawning sites (during fall spawning) and feeding areas (during summer months) between 2020-2022. We then used a newly developed GTseq (Genotyping-in-Thousands by sequencing) panel of 449 single nucleotide polymorphisms to i) infer contemporary stock genetic structure and test for the presence of unknown source populations, ii) assign individual brook trout to their population of origin and iii) determine overall harvest contributions of distinct genetic stocks. Population structure analysis detected admixture between two populations in Mistassini Lake, and it did not reveal any unknown source populations across the three lakes. One source population in Mistassini Lake contributes over half of the lake's total harvest, as well as 16% of the harvest in an adjacent lake (Mistasiniishish). The analysis revealed a two-way migration pattern of brook trout between Mistassini and Mistasiniishish lakes through a waterfall historically reported to be a barrier to dispersal. These results will inform local management for sustainable CRS fisheries in northern Indigenous communities.

Affiliation

MSc student, Concordia University (Fraser Lab)

Presentation type

Oral

Influence of environmental variation on maternal life history responses in divergent brook trout populations

Sofia D'Angelo[1], Dylan Fraser`[1]

[1]Concordia University

Salmonids fishes are diverse and socioeconomically valuable species that are declining worldwide due to human-induced environmental changes. Maternal life history responses are a key component of phenotypic plasticity that may buffer salmonid populations and allow them to persist in unpredictable conditions. Brook trout in Cape Race, Newfoundland exhibit incredible, genetically-based life history diversity despite their small geographic extent. Using common-garden experimentation in captivity, we reared fish from four wild populations under divergent feed regimes to simulate how environmental variation influences maternal life history responses (growth, fecundity, and egg size). Populations were classified as slow, fast, and intermediate growers, as they exhibit two-fold in their somatic growth rates in nature. As early juveniles, individuals were reared on either a high-food or low-food diet. As late juveniles and until maturation, half the individuals were switched to the opposite regime, while the other half remained unchanged. These feed regimes corresponded to resource rich environments (high-high), resource poor environments (low-low) and a reversal of environmental conditions (low-high, high-low). We predicted that females from all populations would exhibit faster growth, higher fecundities and smaller egg sizes in resource-rich environments, but disproportionately so in fast growers compared to slow-growers. Conversely, resource-poor environmental conditions should reduce growth and favour investment in fewer, larger eggs but impose the greatest pressures on fast growers. Our work aims to better understand the extent of variation in intraspecific plastic responses to environmental change in salmonids, with implications for forecasting population persistence.

Affiliation

Concordia University

Presentation type

Poster

Gene transcriptional profiling to assess Chinook salmon osmoregulatory resilience to environmental change.

Shahinur Islam[1], Ken Jeffries[2], John Heath[3], Daniel Heath[1]

[1]University of Windsor, [2]University of Manitoba, [3]Yellow Island Aqauculture Ltd.

Given the unprecedented rapid environmental change experienced by freshwater ecosystems, it is critical to characterize how fish will respond to such change, quantify their adaptive potential, and identify the genomic mechanisms underlying their response. Gene transcriptional profiling provides a powerful methodology to address those needs. Furthermore, non-lethal sampling for transcriptional profiling is preferred, given increasing conservation and animal welfare concerns. Little is known, however, whether the transcriptomic response profiles of non-lethal sampling would be equivalent to traditional lethal tissue sampling. Here, we collected lethal (gill, liver) and non-lethal (skin swab (mucus), gill biopsies and water for eRNA) samples from Chinook salmon (*Oncorhynchus tshawytscha*) juveniles exposed to different osmoregulatory stress treatments (freshwater [control], brackish water and seawater) for 72 h. Using a 28 gene osmoregulatory-relevant “Stress Transcriptional Profiling” nanofluidic qRT-PCR array (STP-chip), we compare gene transcriptional profiles to assess osmoregulatory stress responses at the gene transcription level. We also compare the transcriptional profiles generated using the different sampling methods. Preliminary findings show, as expected, a significant response to the 72 h osmoregulatory stress, with the strongest response being in the full-strength saltwater. Although preliminary, our findings suggest non-lethal sampling will have valuable applications for conservation in wild salmonids and for captive rearing for commercial or supplementation purposes.

Affiliation

University of Windsor

Presentation type

Oral

Assessing the potential of Caenorhabditis elegans in the bioremediation of Microcystis aeruginosa

Jordan Balson[1], Ian Chin-Sang[1], Tassos Anastassiades[1], Yuxiang Wang[1], Daniel Lefebvre[1]

[1]Queen's University

Cyanobacterial harmful algal blooms, or CHABs, can produce dangerous cyanotoxins which dominate freshwater ecosystems, causing damage. *Microcystis aeruginosa* is a common species of cyanobacteria and can produce hepatotoxic and neurotoxic microcystins. The impact of CHABs is immense, and traditional remediation methods are not always adequate in eutrophic regions. As a result, a proactive, targeted approach is needed to bioremediate CHABS. Bioremediation of CHABs with *Viviparus georgianus* (banded mystery snail) is somewhat effective, as the snail filter feeds and ingests intact cyanobacteria cells, which are then translocated to the benthos in pseudofeces or feces. Although this prevents cyanobacteria from entering its disruptive colonial phase, this is temporary, as currents eventually liberate live cyanobacteria cells. Nematodes, such as *Caenorhabditis elegans*, are potential candidates for bioremediating this pseudofeces and feces. We analyzed *C.elegans* health and fat accumulation on a diet of toxic *M.aeruginosa* and found that *C.elegans* are able to ingest, digest and metabolize the diet. It is unclear if a diet of toxic *M.aeruginosa* has some health impacts, however overall, the diet was able to sustain *C.elegans* development and *C.elegans* were tolerant of it. SKN-1 (a central iii regulatory protein to the phase II detoxification system) expression was not significantly greater on a diet of toxic *M.aeruginosa*, suggesting that this diet doesn't induce a stress response. Finally, *C.elegans* populations were observed, and several generations of nematodes were sustained on pseudofeces and feces containing toxic *M.aeruginosa*. Overall, these results suggest that *C.elegans* could be a viable CHABs bioremediation candidate in combination with *V.georgianus.*

Affiliation

Queen's University

Presentation type

Oral

The presence and distribution of cyanophage and putative Microcoleus host in the Wolastoq

Sheridan Hamilton[1], Cecilio Valadez-Cano[1], Adrian Reyes-Prieto[1], Janice Lawrence[1]

[1]University of New Brunswick

Cyanobacteria, colloquially known as blue-green algae, are photosynthetic prokaryotes that inhabit marine and freshwater environments. Some cyanobacteria produce toxic metabolites (e.g., anatoxin) hazardous to human and animal health. Cyanobacterial blooms and benthic accumulations (mats) are therefore of great public health interest worldwide, particularly in New Brunswick after the deaths of four dogs along the Wolastoq|Saint John River (NB, Canada) in 2018 and 2019 after consuming cyanobacterial (*Microcoleus*-dominated) mats containing anatoxin. Cyanophage are viruses that infect cyanobacteria and can alter their population dynamics. Our recent metagenomic survey of Wolastoq mats identified a lytic cyanophage predicted to infect anatoxin-producing strains of *Microcoleus*. To screen a larger sample size, we used a PCR-based approach to examine cyanophage presence. We developed a set of primers to amplify the gene encoding the phage tail protein (PT gene) of the putative Microcoleus cyanophage. We screened the presence of the PT gene in 164 benthic mat samples collected from 8 sites along a 20 km region of the Wolastoq near Fredericton and surrounding areas between June and September 2019. We compared the presence of the cyanophage as detected by the PT gene, and the presence of the toxic *Microcoleus* sp. as detected by amplification of the *anaC* gene, essential for anatoxin biosynthesis. The spatial and temporal distribution of our amplicon data supports that the toxin-producing *Microcoleus* is the host of the putative Microcoleus phage. Future work studying the biology of cyanophage infection of toxigenic *Microcoleus* is important to understand the impact on anatoxin potential and release.

Affiliation

University of New Brunswick

Presentation type

Oral

Genomic Tool Development in Arctic Char to Support Indigenous Fisheries and Food Security in Nunavut

Anne Beemelmanns[1], Emmelie Paquette[2], Océane Perrot[2], Xavier Dallaire[1], Charles Babin[1], Jean-Félix Cabot[1], Eric Normandeau[1], Louis Bernatchez[1], Stephan Schott[2], Jean-Sébastien Moore[1]

[1]Université Laval, [2]Carleton University

Fishing and hunting are essential activities for Inuit communities and sustain food security, healthy diets, and community ties. Arctic char (*Salvelinus alpinus*) is the most harvested and consumed fish in Inuit communities, contributing significantly to food security and representing a crucial component of the Inuit culture. Genomic tools like Single Nucleotide Polymorphisms (SNP) panels are powerful to assess the population structure and migration patterns of anadromous salmonids and support the management of subsistence and commercial mixed-stock fisheries. Our objective is to conduct community-driven research and combine traditional Inuit Knowledge with western science using both harvest and genomic monitoring tools to support the Indigenous-led management of subsistence and commercial Arctic char fisheries in Taloyoak (Nunavut, Canada). We engaged Indigenous harvesters in community-led sampling of Arctic char at four important subsistence fishing sites, plus one current and one potential commercial fishing site on the Boothia Peninsula. We used low-coverage Whole-Genome Sequencing (lcWGS) to sequence the genomes of 213 individuals and analyzed the population genetic structure. Out of 850,738 SNP markers, we selected the most informative 500 SNPs to develop a cost-effective Genotyping-in-Thousands by sequencing (GT-seq) panel. This panel will be used to assign Arctic char individuals from mixed-stock fisheries to their source populations, thus supporting the development and management of new commercial fisheries. Our genomic tool, together with geospatial data based on harvester activities and traditional Inuit Knowledge, will foster the sustainable harvest of Arctic char for subsistence, recreational, and commercial Inuit fisheries, ultimately contributing to food security and economic development.

Affiliation

Université Laval

Presentation type

Oral

Changes in gene expression associated with submersion and exposure of benthic cyanobacterial mats in the Wolastoq

Hannah Geisterfer Nyvlt[1], Cecilio Valadez-Cano[1], Adrian Reyes-Prieto[1], Janice Lawrence[1]

[1]University of New Brunswick

Benthic microbial mats are home to a multitude of organisms and are frequently dominated by cyanobacteria capable of producing potent toxins, such as anatoxin-a (neurotoxin). These mats are present in the Wolastoq|Saint John River (NB) and due to flow regulation for hydroelectric generation are regularly subjected to rapid environmental changes through daily fluctuations in water levels causing an increase of certain stressors (light exposure, temperature, desiccation) for the associated microbial community. Here, we aimed to explore the effect of these stressful conditions on the metabolic responses within the mat community, with emphasis on the dominating cyanobacteria capable of anatoxin-a production. To understand the impact of the submersion/exposure cycles on Wolastoq mat community, we investigated overall changes in gene expression levels to infer modulation/regulation of the prevalent microbial metabolic routes in the mat. Triplicate mats were sampled while submerged under the water and again after an hour of exposure. Samples were extracted and sequenced with Illumina technology for mRNA abundance. The SqueezeMeta pipeline was used to analyze the recovered transcripts and to compare their abundance in key pathways involved in nitrogen, oxygen, phosphorus, and sulphur metabolism in the three highest transcriptionally active phyla, Cyanobacteria, Proteobacteria, and Bacteroidetes. The anatoxin biosynthesis pathway was not detected in any of the samples, indicating that the condition change had little to no effect on the toxin production. By better understanding the metabolic pathways of these mats, we can gain insight into how the bacterial community works together to proliferate in a stressful environment.

Affiliation

University of New Brunswick

Presentation type

Oral

Limitations of non-volitional upstream passage for alewife (Alosa pseudoharengus) and blueback herring (Alosa aestivalis)

Fishways that rely on mechanical structures (e.g., lifts, locks, and transport systems) to move fish around a barrier are considered “non-volitional” because they prevent fish from passing at the time of their choice. We used PIT telemetry (n = 10,292 fish tagged, 4 years) to evaluate upstream passage at a non-volitional (trap, lift, and truck) fishway that passes between 1-3 million river herring (*Alosa* species) each year at the lowermost dam on the Wolastoq | Saint John River, NB. Between 26% and 62% of tagged fish reached the fishway crowding pool, while less than 14% passed upstream. River herring experienced considerable passage delays after reaching the crowder entrance (max = 27 days) and made multiple attempts to pass. The probability of passing on the date of first detection was only 10%, and positively correlated with the rate of fishway operation (i.e., fish lifts/unit time). The rate and probability of passage were greater for alewife than blueback herring and increased with total-length for both species. The fishway failed to provide timely passage as migrants became available, resulting in a migratory bottleneck that contributed to upstream passage delays, low passage efficiency, and selective passage conditions that favored larger individuals and alewife over blueback herring. Ultimately, this study suggests that non volitional fishways may create additional conservation and management challenges if their design and operation regimes do not consider the size and behavior of target populations.

Affiliation

Canadian Rivers Institute; University of New Brunswick, Fredericton

Presentation type

Oral

Beyond a knowledge-deficit approach: perceptions of AIS risks in the Laurentian Great Lakes

Gadfly Stratton[1], Nicole Klenk[1], Nicholas Mandrak[1]

[1]University of Toronto, Scarborough

Policy guidance for the management of aquatic invasive species (AIS) tends to stress the importance of education of the public about AIS risks. The intention behind this is generally to promote public cooperation with management objectives. The public has also increasingly become a source of local information about their communities, invasion vectors, and AIS impacts. It is not yet known how public perceptions of AIS risks, in turn, inform AIS management decisions. Our research examined the amount of information available to Great Lakes stakeholders (publics, policy-makers, academics), and whether it was associated with AIS risk perceptions. Participants were surveyed to determine the amount of knowledge and experience they had with AIS in general and with three case-study species (Tench, Grass Carp, Sea Lamprey). This was then compared to participants' quantification of the level of risk they ascribed to those AIS. While our results found that species that were further along the invasion curve were perceived as a greater risk, the degree of risk was largely unassociated with the amount of information reported by participants. These findings suggest that a focus on education alone is insufficient to ensure stakeholder perceptions of greater risk, and that factors other than amount of information contribute to stakeholder risk perceptions of AIS.

Affiliation

University of Toronto Scarborough

Presentation type

Oral

Using transcriptional profiling to identify how food deprivation increases the thermal tolerance of lake sturgeon (Acipenser fulvescens)

Kyle Madden[1], Hossein Haghighi[2], Ken Jeffries[2], Nicholas Bernier[1]

[1]Department of Integrative Biology, University of Guelph, [2]Department of Biological Science, University of Manitoba

In response to climate change, freshwater fish are facing a higher frequency of heatwaves, increased energetic costs, and a reduced predictability of food availability - conditions that may reduce energy reserves and jeopardize thermal tolerance. Yet, little is known about the relationship between energy reserves and thermal tolerance in fish. Therefore, we assessed how energy reserves affect the thermal tolerance of a long-lived species of conservation concern, lake sturgeon, and used a sturgeon-specific 52-gene OpenArray chip to determine whether energetic status affects the transcriptional response to an acute thermal challenge. Relative to fed fish, fasting for 5 or 10 weeks consistently increased thermal tolerance as determined by standardized critical thermal maximum (CTmax) trials. Independent of feeding status, the CTmax thermal challenge elicited the differential expression of 32 and 27 genes across various functional groups in the liver and gills, respectively, and fasted fish were characterized by a distinct transcriptional profile. In the liver, fasted fish had lower expression of growth- and metabolism-regulating genes, and fasting magnified the cellular stress response associated with the CTmax trials. Fasting also reduced the impact of the acute thermal challenge on the expression of hypoxia-responsive and metabolic genes in the gills. Therefore, contrary to our prediction, we demonstrate that lake sturgeon with reduced energy reserves have an enhanced thermal tolerance and suggest that this resilience is at least partially mediated through a general suppression of transcriptional activity and an enhanced cellular stress response. This work was funded by the Government of Canada through Genome Canada.

Affiliation

University of Guelph / Department of Integrative Biology

Presentation type

Oral

Evaluation of light as a behavioural guidance mechanism to reduce turbine-related mortality of out-migrating American Eel on the St. Lawrence River

Chris Elvidge[1], Thomas Pratt[2], Steven Cooke[1], Cole MacLeod[1]

[1]Carleton University, [2]Fisheries and Oceans Canada

Anguillid eels have fascinated and fed humanity for thousands of years. Perhaps due in part to this, their abundance has declined precipitously worldwide, and most species range from Threatened to Critically Endangered. As diadromous fishes, they are also particularly susceptible to riverine obstructions, such as dams. The quantity of juvenile American Eels migrating up the St. Lawrence River into Lake Ontario, as measured at the Moses-Saunders Hydroelectric Dam Eel Ladder, has declined 95-99% since the 1970s. Cumulative mortality in downstream-migrating eels as a result of turbines at Moses-Saunders and Beauharnois Generating Station is near 40%. There is a need for innovation to develop new mechanisms to reduce turbine mortality. Behavioural guidance using LED lighting has proved effective in a laboratory environment. Thus, a 216 m LED light array was installed upriver of the Iroquois Dam on the St. Lawrence River, the first management-scale evaluation of light to guide eels. We describe preliminary results from 400 late yellow-stage eels which were implanted with acoustic tags and released in Lake Ontario to be detected by an array of acoustic receivers near the light array. If eels can be guided with light it provides opportunities for reducing turbine mortality by directing eels toward safe passage or to collection facilities for trap and transport.

Affiliation

Carleton University

Presentation type

Oral

Developing fish population forecast triggers for adaptive monitoring programs

Adaptive monitoring programs can be a great tool to determine when there are unanticipated consequences of development. Adaptive monitoring responds to the presence of meaningful environmental changes by focusing resources on issues and sites that need more focus to collect sufficient information for decision-makers. When new industrial developments occur, adaptive, post-development monitoring programs will provide the best information when it is linked to monitoring triggers developed from pre-development baselines, and to forecast triggers based on modelling predictions of anticipated changes. Iterative development of models and monitoring provides a feedback loop to improve both processes and to focus on the highest risks. Unfortunately, the current best practice for Environmental Impact Assessment (EIA) focuses modelling on stressors (physiochemical aspects) and ignores or only qualitatively discusses potential changes to biota from development. In undisturbed situations, fish population characteristics and benthic invertebrate communities (fish habitat) show natural variability between years associated with environmental drivers, most commonly flow and temperature. Baseline data and effective models of factors driving natural variability should provide estimates for post-development variability in the absence of impacts. The lack of quantitative biotic modelling during EIAs makes it difficult to generate forecast triggers for these endpoints. This presentation will discuss three quantitative modelling methods for fish population health endpoints and how those can be used to generate a forecast trigger.

Affiliation

Wilfrid Laurier University

Presentation type

Oral

Impacts of 2014 Iqaluit “Dumpcano” on metal concentrations in sediment

Jose Roginal Gabriel Atienza[1, 2], Jesse Vermaire[1, 3], Murray Richardson[1, 3]

[1]Carleton University, [2]Student, [3]Co-Supervisor

Nunavut’s largest city, Iqaluit, experienced an environmental challenge in 2014 with a landfill fire. This study delved into the aftermath of this fire, employing sediment core analysis from a nearby lake, Lake 1, to determine its environmental implications. Examination of the sediment cores revealed fluctuating moisture and organic matter content without evident depth-related trends. The predominant inference was an inorganic composition for the sediments, possibly influenced by regional topography and limited organic matter input. The core of this research was the assessment of heavy metal concentrations, including lead, nickel, mercury, and manganese, which showed a notable increase closer to the sediment surface. These metals, known for their bioaccumulated and enduring attributes, posed potential risks to aquatic ecosystems and human health, surpassing established drinking water standards. Notably, diatom analysis was also performed, revealing valuable insights. The analysis indicated varying diatom compositions at different intervals, suggesting subtle responses to environmental changes. However, cautious interpretation is required due to the complexity of factors influencing diatom populations, such as shifts in temperature, ice cover, and environmental dynamics. Variables such as lake system, depth, species weight, and glacial history emerged as influential factors in diatom dynamics. This comprehensive study, encompassing sediment core analysis, heavy metal assessment, and diatom analysis, sheds light on the intricate dynamics of environmental changes in the Arctic region. The identified risks of metal contamination and nuanced responses of diatom populations highlight the importance of continued research in preserving the delicate balance of northern freshwater ecosystems.

Affiliation

Carleton University

Presentation type

Poster

On Parity of Isotopic and Trophic Niches

Bobby Nakamoto[1], Kimmo Kahilainen[2], Brian Hayden[1]

[1]University of New Brunswick, [2]University of Helsinki

Ecologists often struggle to distill tangible and intangible aspects of communities, populations, and organisms into quantitative, intercomparable, metrics. For this reason, countless measurements and proxies have been devised to describe seemingly every aspect of an organism's ecological niche. One popular framework is the, "isotopic niche," wherein measurements of consumer stable isotope compositions are leveraged to describe individual-level resource selection, and population-level variability (i.e. generalist vs specialist). However, carbon and nitrogen are the most commonly used elements to characterize the isotopic niche and carbon and nitrogen in consumer tissues comes from consumed prey. Thus, the isotopic niche is commonly conflated with the trophic niche. Our present work explores incongruence of the isotopic and trophic niche. Specifically, we demonstrate how systematic spatial variability in the stable isotope composition of prey items can skew trophic-centered interpretations of the isotopic niche. To do this, we used stable isotope measurements of invertebrates and fish from lakes in Finland alongside simulation modeling to describe the relationship among isotopic niche characteristics and more traditional measures of the trophic niche, such as gut content analysis. Our results indicate that covariance of trophic and isotopic niches is strong when resource selection gradients are parallel to isotopic gradients. However, our analyses also indicate that while expansions in the isotopic niche can be correlated to increased trophic niche breadth, the two quantities are not inexorably linked. Therefore, interpretation of the isotopic niches as a direct analog of the trophic niche should be done cautiously.

Affiliation

Stable Isotopes in Nature Laboratory

Presentation type

Poster

Seasonal acclimation of cardiac adrenaline regulation and heat tolerance in lake char (Salvelinus namaycush) in the Central Canadian Arctic.

Emily Williams[1], Ben Speers-Roesch[1], James Kieffer[1], Matthew Gilbert[2]

[1]University of New Brunswick Saint John, [2]University of Alaska Fairbanks

Northern climates are characterized by extreme seasonality which can challenge critical physiological processes, including cardiac function. During warming, heart rate in fish generally increases, which supports increased tissue oxygen demands but only up to a critical temperature threshold, where peak heart rate is reached. Conversely, at cold winter temperatures, heart rate is slowed. Available single-species studies have revealed considerable diversity in the responses of heart rate to temperature change among fishes, but the mechanistic basis and significance of this diversity is unclear. For example, adrenaline in fishes can be critical for heart function (e.g., heart rate) at thermal extremes, but the extent to which any thermal acclimation of cardiac temperature sensitivity is driven by changes in adrenergic regulation requires exploration. Using an electrocardiogram approach, we investigated seasonal changes in cardiac heat tolerance and adrenergic sensitivity in winter-and summer-acclimated lake trout in the Central Canadian Arctic. Fish were anaesthetized, fitted with subdermal electrodes, and received a drug injection to elicit either maximum or intrinsic heart rate, with the difference between these rates indicative of adrenergic sensitivity. Fish were then acutely warmed until heart rate peaked, and cardiac arrythmia began, indicating heat induced heart failure (an upper cardiac thermal limit). We found no changes in heat tolerance between seasons but found that adrenaline sensitivity was more pronounced at high temperatures in winter-acclimated fish. Overall, our results suggest that lake char in the Arctic seasonally adjust cardiac adrenergic control to maintain performance under prevailing conditions, but this does not impact cardiac heat tolerance.

Affiliation

University of New Brunswick Saint John

Presentation type

Oral

The evolution and ecology of freshwater mussel parental care

North America is a hotspot for freshwater mussel diversity. They are ecosystem engineers, providing key services such as pelagic-benthic coupling for the rivers and lakes they inhabit. There are over 50 species of freshwater mussels in eastern North America but unfortunately they are one of the most at-risk aquatic taxa. In the Canadian Maritimes there were 11 species of mussels; one was extirpated, and two are considered ‘special concern’ under COSEWIC and threatened under the province of Nova Scotia. Of the 10 extant species in the Maritimes 9 are from the family Unionidae. Unionid mussels are unique for studying evolutionary ecology because they have parental care (brooding), an obligate parasitic life history stage (larvae called glochidia), and in some cases they produce lures to improve odds of successful transmission.

I am conducting an updated literature review on life history characteristics of northeastern North American unionid mussels. I will be mapping evolutionary characters for eastern North American such as brooding time and host specificity, onto a pre-existing phylogeny. I hypothesize that: 1) host species and specificity will be more to do with geography than phylogeny due to range overlaps with host fishes; 2) the evolution of lures will be related to host fish prey items and hunting behaviour. Understanding the evolution and ecology of such an important and also at-risk group of species can help with the management and implementation of recovery plans.

Affiliation

St. Francis Xavier University

Presentation type

Oral

Transcriptomic profiles of fathead minnow (Pimephales promelas) from a stormwater-dominated tributary of the Bow River

Marcus Hecker[1], Patricija Marjan[2], Carly Colville [1], Kelly Munkuttrick[2], Fateme Taridashti[2]

[1]University of Saskatchewan, [2]University of Calgary

The Nose Creek Watershed is a small stormwater-dominated tributary receiving inputs from >135 stormwater outfalls as it flows towards Bow River at Calgary. This study examined the responses of fathead minnow (*Pimephales promelas*) (i.e., condition factor (K), liversomatic (LSI), gonadosomatic index (GSI)) and altered metabolic pathways across the Nose Creek watershed using the EcoToxChip® gene array. Fathead minnow were collected at seven locations across the Nose Creek watershed in May 2023, ranging from agricultural and grassland areas in upper West Nose Creek to highly industrialized and residential areas in the lower basin. Fish were measured for length, weight and organ weights; gonads and livers were preserved for molecular analyses. There were no significant differences in condition factor among the sites both for male and female; however, the LSI of male and female in fish inhabiting the most downstream site was highest when compared with fish collected from the other sites. No significant differences were observed in the GSI of female fish between the sites, while there was significant difference in GSI of male fish. EcoToxChips consisting of 375 evidence-based gene targets with the primers for fathead minnow were used to measure the transcript levels of genes. In total 87 genes were up/down regulated, among of these genes, 24 were same in all three sites when compared with West Nose Creek. These genes are associated with metabolism, detoxification and stress response, endocrine system, and signalling pathway in fish from Nose Creek sites compared to West Nose Creek at Mountain View Road.

Affiliation

University of Calgary

Presentation type

Oral

Evidence for a seasonal continuum concept in temperate streams?

Brian Hayden[1], Bobby Nakamoto[1], Jesse Bellamy[1], Rachel Forbes[2], Stephanie Graves[3]

[1]University of New Brunswick, [2]Memorial University of Newfoundland, [3]Queens University

The river continuum concept is the bedrock for much of our understanding river ecosystem function. However, this classic representation of a river shifting from allochthonous to autochthonous driven production through its watershed largely omits seasonal changes in the prevalence of both pathways. Addressing this omission is increasingly important as temperate winters become shorter and less intense.

We used a multi-tracer, stable isotope-based approach to test an hypothesis that allochthonous inputs to temperate streams prevail in fall and early spring whereas the autochthonous pathway is strongest in early summer. We tested this hypothesis across multiple sites on two river catchments in eastern Canada, with repeat sampling of primary producers and benthic macroinvertebrates conducted in early spring, mid-summer and late fall.

Our results highlight stark spatial and temporal variation in stream food web structure in the region. While our hypothesis was broadly supported by the data further investigation will be required to better elucidate the effect of anthropogenic activities (nutrient load) and physical parameters (i.e. channel width, slope etc.) on seasonal variation in food web structure.

Affiliation

Canadian Rivers Institute, University of New Brunswick

Presentation type

Oral

DOES BODY SIZE DRIVE DIEL HORIZONTAL MIGRATION OF ZOOPLANKTON IN TEMPERATE LAKES ?

Cécilia Teillet[1], Marco A. Rodríguez[1], Andrea Bertolo[1]

[1]Groupe de recherche interuniversitaire en limnologie (GRIL) and Centre de recherche sur les interactions bassins versants - écosystèmes aquatiques (RIVE), Université du Québec à Trois-Rivières

Lacustrine zooplankton can perform diel vertical migrations to maximize resource acquisition while reducing the risk of predation. Zooplanktonic organisms may also adopt an alternative (or complementary) strategy, performing diel horizontal migration (DHM), cyclical movements towards and away from the shoreline. DHM occurs in some littoral systems on small spatial scales (tens of meters), but little is known regarding the distances over which DHM occurs and the variation in migration patterns across taxa. We analyzed the effect of individual size on DHM by quantifying zooplankton densities at day and nighttime along transects perpendicular to the shoreline in three lakes in La Mauricie National Park, Quebec. Two planktivorous fish species, brook charr and pearl dace, were present in all lakes. We used a joint species distribution model to assess how zooplankton densities, grouped by taxon and body length class, varied over the diel cycle as a function of distance from shore. We predicted that changes in zooplankton density along a littoral-pelagic gradient would vary as a function of body size and would differ between daytime and nighttime. We examine the results in light of context-dependent changes in predation risk with increasing body size, and discuss whether DHM by zooplankton can contribute to horizontal transfers of mass and energy and thereby couple pelagic and littoral zones in this system.

Affiliation

Université du Québec à Trois-Rivières

Presentation type

Poster

Diversity and evolution of benthic mat-forming Microcoleus in Atlantic Canadian freshwater ecosystems

Cecilio Valadez-Cano[1], Yannan Huang[2], Adrian Reyes-Prieto[1], Lindsay Johnston[2], Hannah Morris[2], Rob Jamieson[2], Janice Lawrence[1]

[1]University of New Brunswick, [2]Dalhousie University

Proliferation of benthic cyanobacterial mats dominated by *Microcoleus* species in freshwater ecosystems has raised concerns due to their potential to produce anatoxin, a potent neurotoxin. In this study, we conducted shotgun DNA sequencing of benthic mats collected in Nova Scotia and New Brunswick. Our metagenomic analysis revealed the presence of at least 8 new *Microcoleus* species dominating these cyanobacterial mats. Two of the novel *Microcoleus* species contain the gene cluster for anatoxin production. One of the new species with the anatoxin biosynthesis potential was found in both provinces, while the second was exclusive to Nova Scotia. Our phylogenetic analysis of *Microcoleus* species from Atlantic Canada and reported worldwide revealed a monophyletic group of the anatoxin-producing *Microcoleus* intermingled with non-toxigenic close relatives. Comparative genomics of diverse *Microcoleus* species suggest a single acquisition of the anatoxin cluster in their common ancestor, followed by multiple independent losses of the cluster during the divergence of the different *Microcoleus* lineages. Our findings revealed cryptic genetic diversity in the *Microcoleus* genus dominating freshwater benthic mats and provide insights into the evolutionary processes related to the acquisition and loss of the anatoxin cluster.

Affiliation

University of New Brunswick

Presentation type

Oral

Patterns in benthic cyanobacteria mat proliferation in the Fredericton Region of the Wolastoq

Marisa Forbes[1], Meghann Bruce[1], Daniel Beach[2], Pearse McCarron[2], Xavier Ortiz Almirall[3], Diego Alonso[3], Janice Lawrence[4]

[1]Canadian Rivers Institute UNB, [2]Biotoxin Metrology, National Research Council, Halifax, NS, [3]IQS School of Engineering, Universitat Ramon Llull, Barcelona, Spain, [4]University of New Brunswick

In 2018 three dogs died as a result of ingesting toxin-producing cyanobacteria while walking along the shoreline of the Wolastoq in the Fredericton (New Brunswick, Canada). Microscopy analyses of vomitus from the dogs tentatively identified *Microcoleus* as the potential cyanobacteria responsible and liquid chromatography-high-resolution mass spectrometry (LC-HRMS) identified anatoxin-a as the toxin ingested. At the time of the dog deaths, there were no records of cyanobacterial blooms for this region and the presence of toxin-producing cyanobacteria evoked public concern as there was little information available to ascertain the extent of the risks in the Wolastoq. The objective of this study was to investigate the source and temporal-spatial extent of anatoxin-a production in the Fredericton Region of the Wolastoq. The findings of our investigation have identified patterns in benthic cyanobacteria proliferation and challenged our previous understanding of the environmental conditions that give rise to benthic cyanobacteria blooms. Here we will discuss the environmental patterns we have identified and key findings from what we have learned about benthic cyanobacterial mat proliferation in this region over the past 5 years.

Affiliation

Canadian Rivers Institute, University of New Brunswick

Presentation type

Oral

Cultivating Knowledge: an interdisciplinary synthesis of what we (don't) know about captive rearing programs for salmon conservation and fisheries in a Pacific and Atlantic basin context

Hannah L. Harrison[1], Øystein Aas[2], Valerie Berseth[3], Tom Chance[4], Katherine Dalby[1], Shelley Denny[5], Norm Johnson[6], Lian Kwong[7], Adrian Spidle[8], Alan Walker[9], Kyle Wellband[7], Lorna Wilson[10], Kurt M. Samways[11]

[1]Dalhousie University, [2]Norwegian University of Life Sciences, [3]Carleton University, [4]Lummi Indian Nation, [5]Unama'ki Institute of Natural Resources, [6]Ha'oom Fisheries Society, [7]Fisheries and Oceans Canada, [8]Northwest Indian Fisheries Commission, [9]Centre for Environment, Fisheries, and Aquaculture Science (CEFAS), [10]Alaska Department of Fish and Game, [11]University of New Brunswick

Anadromous salmonids (*Oncorhynchus*, *Salmo* sp, etc.) have undergone declines due to factors including climate change, migratory corridor fragmentation, overfishing, habitat loss/change, disease, parasites, and impacts from aquaculture. Programs to captively rear and release salmon have been used across life-stages, scales, and contexts in the Pacific and Atlantic basins in efforts to support salmon populations and mitigate loss. These programs have had mixed results (i.e., positive, neutral and negative outcomes) in meeting their various objectives. Policies have generally supported these practices but have diverged across conservation contexts and jurisdictions, often aiming to reduce negative effects of captive rearing and stocking. While the natural science literature on this topic is relatively robust, the expanding field warrants a review of the state of knowledge about captive rearing and stocking. Moreover, knowledge syntheses in this field have yet to consider the body of human dimensions research on these topics, particularly from knowledge systems and traditions outside of academia (*e.g.*, Indigenous knowledge). To address these gaps, this study synthesizes 10 years of peer-reviewed literature to elicit key ecological, biological, and social understandings of stocking/captive rearing programs for salmon in the Pacific and Atlantic basins. We frame this interdisciplinary synthesis in the context of climate change to better understand what role captive rearing could play in conserving future wild populations and/or supporting fisheries. We attend to what topics and knowledge systems are *not* represented in this search, and how those exclusions may influence the scientific debate as well as on-the-ground decision-making for captive-rearing and stocking efforts.

Affiliation

Dalhousie University

Presentation type

Oral

Greenland shark (Somniosus microcephalus) local abundance estimates in the Eastern Canadian Arctic

Rachel A. S. Forbes [1], Jonathan A. D. Fisher[1]

[1]Marine Institute of Memorial University of Newfoundland

Greenland sharks (*Somniosus microcephalus*) are large, deep-sea sharks that have slow metabolisms, resulting in slow growth, late maturity, and the longest estimated vertebrate lifespan. These traits interact, causing the sharks to be vulnerable to overfishing. Although there is no directed fishery for Greenland sharks in the Canadian Arctic and Subarctic, it is estimated that more than 1700 individuals are caught annually as bycatch in these regions. Local abundances and distributions of Greenland sharks have not been well studied, and the global population size remains unknown. Our research objective is to estimate local abundances of Greenland sharks in the Eastern Canadian Arctic and Subarctic using Baited Remote Underwater Video (BRUV) deployments. We combined previous BRUV footage (n ~ 40) taken over several expeditions in Eastern Canadian Arctic and Subarctic waters since 2015, as well as deployed a further 30+ BRUVs in the summer and fall of 2022 and 2023. The BRUV lander systems are equipped with bait, a high-definition camera, reference lasers, and a white light source, and are dropped to the bottom of the ocean recording continuously for 6-10 hours before being retrieved. We can gain valuable information from this non-invasive study method, such as shark length, swimming speed, behaviour, and individual traits, which can then be used in models to estimate local shark abundance. It is important to evaluate Greenland shark biogeography so that this vulnerable species can be protected and be considered in the sustainability assessments of established and expanding Arctic fisheries.

Affiliation

Marine Institute of Memorial University of Newfoundland

Presentation type

Poster

Expanding water level and temperature monitoring in remote Atlantic salmon rivers

Emilie Geissinger[1], Brianna Newton[1], Chelsea Bloom[1], Curtis Pennell[1]

[1]Fisheries and Oceans Canada

Water temperature and water level are significant environmental factors affecting ecology of anadromous fish. Large-scale freshwater monitoring networks remain sparse, yet environmental protocols rely heavily on water temperature and water levels to assist decision making on river closures. Our river monitoring project in Newfoundland and Labrador provides near real-time environmental data (i.e. water temperature and depth, air temperature, and rainfall) and increased spatial and temporal coverage for salmon rivers. As of 2023, we have deployed 18 cellular near-real time monitoring stations and 215 temperature loggers across 39 river systems in Newfoundland and Labrador. Water temperature on monitored rivers has increased in Labrador, with an average summer temperature of 17.1 °C in 2023 compared to 12.8 °C in 2022, and an average autumn temperature of 13.8 °C in 2022 compared to 9.3 °C in 2023. Water temperature in Newfoundland has remained consistent across the two monitoring years, with an average summer temperature of 19.8 °C in 2022 and 18.0 °C in 2023, and an average autumn temperature of 15.5 °C in 2022 and 2023. We will present the methods used to expand monitoring across the region and identify challenges in large-scale temperature monitoring programs and highlight the importance of compiling datasets with large spatial and temporal ranges. Monitoring water temperature across a large spatial and temporal range will allow researchers to further understand growth, survival, and distribution. These data are valuable resources to assess climate change impacts on declining salmon populations.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

An inter-connected benthic to pelagic baseline of the Bay of Fundy marine food web.

The Bay of Fundy is a diverse ecosystem supporting a complex ecological network of native, invasive, and migratory species. Several of these species have well understood ecology and life history characteristics; however, the resource pathways that fuel this community are understudied. Marine food webs are typically fuelled by two primary food chains, the pelagic and benthic, which can be coupled by both biotic and abiotic processes. This interaction and transfer of nutrients, energy, and mass between the pelagic and benthic food chains underpin the food web processes supporting these charismatic species. Therefore, a thorough understanding of the Bays' food web is required to elucidate the source and fate of organic material within the Bay. We combined stomach content analysis with carbon and nitrogen stable isotope measurements of 18 fish and 13 invertebrate species to estimate benthic-pelagic coupling in this ecosystem. Contrary to our expectations, that pelagic detritus is the primary source of production in the Bay, the fish community derived between 22 to 76 % of their resources from the benthic food chain. Comparison of stomach content and stable isotope data indicated that benthic-pelagic coupling was moderate. The Bay has some of the largest tides globally and our data indicate that the movement of such a large volume of water could be displacing coastal production driving a previously underscribed nearshore-offshopre coupling process in the Bay. This study will provide information about the connectedness of the ecosystem and assist in improving management and conservation practices.

Affiliation

UNB

Presentation type

Poster

NexTrak: The Future of Acoustic Telemetry

Peter MacLeod

Acoustic telemetry is a well-established tool that has been used worldwide for decades to understand spatio-temporal movements and associated behaviour of a wide range of aquatic animals. Emerging technologies are continually being developed to open up new avenues of research. Since 1979, Innovasea (formerly Vemco) has been dedicated to advancing the science of acoustic telemetry to enable researchers to conduct behaviour, migration, and fine-scale positioning studies.

NexTrak, Innovasea's breakthrough acoustic telemetry system, is ushering in a new era of science, collaboration, and discovery for aquatic animal researchers. It delivers improved performance and higher quality data, enabling scientists to explore new habitats and more challenging environments. The R1 receiver is the first product available as part of a larger NexTrak ecosystem of new receivers, transmitters, and enhanced cloud-based tools that will provide researchers with a richer, more complete picture of animal behaviour. Recent R1 field tests show 40 percent greater range than previous receivers which reduces the number of receivers required to cover the same area. Its advanced processor is better at filtering out noise and decoding tag transmissions leading to twice as many detections while also enabling researchers to reliably track fish in challenging acoustic environments.

Data from the NexTrak system is managed in Fathom, a suite of software tools that has revolutionized data management, from collection and curation to analysis and storage. Fathom lets researchers maintain secure ownership of their valuable data while providing the option to easily share it with their colleagues of choice anywhere in the world.

Affiliation

Innovasea

Presentation type

Oral

Seasonal variation in thermal tolerance and hypoxia tolerance of a threatened minnow and a non-imperilled congener

Jessica Reemeyer[1], Lauren Chapman[1]

[1]McGill University

Freshwater organisms face multiple threats to their ecosystems, including warming associated with climate change and low dissolved oxygen (environmental hypoxia), which are both increasing in frequency and extent in freshwater systems. Understanding tolerance thresholds for these environmental stressors as well as the plasticity of responses is key for informing conservation of imperilled species. In this study, we measured physiological performance of two species: one federally listed as threatened in Canada (Pugnose Shiner, *Notropis anogenus*) and a non-imperilled congener (Blackchin Shinner, *Notropis heterolepis*). Routine metabolic rate, hypoxia tolerance (critical oxygen tension), and upper thermal tolerance (CT_{max}) were measured streamside over a period of five months. These nonlethal experiments were performed in the field on fish directly after collection and will therefore inform on the environmental tolerances of wild fish as well as the seasonal plasticity in these traits, and how vulnerable these fish are to climate warming and increasing hypoxia. Moreover, the comparative framework (imperilled versus non-imperilled congeners) provides insight into drivers of imperilment, and the value of surrogate species as a conservation tool. We find that CT_{max} is generally higher in the non-imperilled Blackchin Shiner, indicating an increased physiological tolerance of elevated temperatures. We conclude that researchers should be cautious when using surrogate species to inform tolerance limits of imperilled species, as they may represent an overestimate of true tolerance.

Affiliation

McGill University

Presentation type

Oral

Dispersal distance and direction of stream salmonids from nests and stocking sites: variability and sampling bias

James Grant[1], Laura Weir[2]

[1]Department of Biology, Concordia University, [2]Department of Biology, Saint Mary's University

Dispersal is a crucial demographic factor affecting the degree of local adaptation and the persistence of meta-populations. In stream salmonid populations, the degree of dispersal plays an additionally important role in conservation and restoration plans. Millions of trout and salmon are released every year in streams around the world to support local fisheries and to maintain or restore wild populations. How and where to release fish will depend on how far and in what direction they disperse. While classic papers suggest that young salmonids do not disperse far from nests or stocking sites, and primarily in the downstream direction, some recent papers suggest much greater variability. To reconcile these divergent views, we conducted a systematic search and quantitative analysis of dispersal data for 155 populations from 7 different species: Atlantic salmon = 73, brown trout = 25, rainbow trout = 23, brook trout = 17, Masu salmon = 11, cutthroat trout = 6, and European grayling = 1. On average, 65% of fish dispersed downstream, much lower than expected, and the range varied from 0-100%. Fish dispersed a mean distance of 410 m from the release site, much greater than expected, but the range also varied from 0-3560 m. Our preliminary analysis suggests that the best predictors of dispersal direction and direction include species, body size and sampling bias. These results have important management implications about how and where to release fish.

Affiliation

Department of Biology, Concordia University

Presentation type

Oral

Co-occurrence of cyanotoxins and phycotoxins in the Southeast Asian largest brackish water lagoon Tam Giang - Cau Hai (Vietnam)

Tri Nguyen-Quang[1]*, Gia Hang-Nguyen Thi[2], Thi Thu Hoai Ho[3], Thi Thuy Hang Phan4, Ni Tran[4], Duong Thu Huong Hoang[4], Devleena Sahoo[1], Noureddine Bouaïcha[5]*

[1] Biofluids and Biosystems Modeling Lab, Dalhousie University, Canada; [2] University of Science-Vietnam National University, Ho Chi Minh City, Vietnam; [3] University of Aquaculture and Forestry, Hue University, Hue, Vietnam; [4] University of Sciences, Hue University, Hue, Vietnam; [5] Laboratory Ecology, Systematic and Evolution, UMR 8079, University Paris-Saclay, France

The Tam Giang-Cầu Hai Lagoon of Thừa Thiên Huế province (Vietnam) is a marsh/lagoon system among the largest in Southeast Asia with an area of 22,000 ha and a length of 70 km. It plays a significant role both in terms of socio-economic and environmental resources. However, the pressures accumulating by many activities such as tourism, aquaculture and urbanization; in addition to the three major rivers that receive the discharged untreated domestic and industrial sewage and agricultural runoff, which is further carried into the lagoon, especially after heavy rains and flash floods; triggers the trend towards continuous degradation of its water quality following proliferation of toxic dinoflagellates and cyanobacteria. In the present study, physicochemical factors and some cyanotoxins (anatoxins, saxitoxins, and Microcystins) and phycotoxins (saxitoxins and okadaic acid and derivatives) were analyzed in water and shellfish in June 2023 from 13 stations by Enzyme-Linked Immunosorbent Assay (ELISA) kits for anatoxins and saxitoxins and serine/threonine phosphatase type 2A (PP2A) inhibition assay kit for Microcystins and okadaic-like toxins. Anatoxins were detected only in some sites at low concentrations. However, saxitoxins, microcystins and okadaic-like toxins were detected in all sampled sites and shellfish samples with concentrations in some sites exceeding 1 µg/l and 20 µg/kg, respectively. These results show for the first time the co-occurrence of phycotoxins and cyanotoxins in this lagoon. Therefore, monitoring these toxins in shellfish produced in this lagoon would be necessary to assess the further risks for seafood safety, human and animal health and productivity of shellfish.

Affiliation

Dalhousie University

Presentation type

Oral

A world with dew still on it: Jeff Hutchings in the Arctic.

The invitation to deliver this lecture read, in part "…given your unique perspectives on Jeff's contributions to understanding fisheries and evolutionary ecology during your tenure as his graduate student". It is fair to say that honouring Jeff's academic contributions is best left to others more familiar and qualified than myself. This lecture will focus instead on the "unique perspectives" that I gained during of a number of Arctic field seasons with Jeff in the early 2000s. In remote field camps on Baffin and Ellesmere Islands, cut off from the outside world, I had the privilege to bond with Jeff in these beautiful and fascinating environments. Freed from the intense pace and constant demands of his busy life, Jeff emerged as a calm and curious natural historian, botanist, photographer, screaming skinny-dipper and prodigious consumer of Chips-Ahoy. Rich in photography and anecdotes, this lecture aims to share these adventures and experiences and to honour a different side of Jeff than many in the audience are likely to have experienced.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

Comparison of two semi-automated methods for estimating salmon river grain size from LiDAR data

Mathias Chabal[1], Charles Gignac[1, 2], Claudie Boyer[1], André St-Hilaire[1], Jean-Nicolas Bujold[3], Normand Bergeron[1]

[1]INRS, [2]CGQ, [3]MELCCFP

Riverbed granulometry is one of the key variables for Atlantic salmon (*Salmo salar*) habitat. Although the method for measuring this variable is relatively simple to perform in the field, it becomes extremely time-consuming when applied to the entire course of rivers. A few authors have proposed the use of remote sensing to estimate substrate grain size distribution from topographic and hydrological data (Buffington et al. 2004, Gorman et al. 2011, Snyder et al. 2012). We undertook a comparison of the methods of Buffington et al. (2004) and Gorman et al. (2011) with the aim of applying the most optimal model for assessing Atlantic salmon habitat quality in rivers. Buffington's model is based on the estimation of the hydraulic competence of the stream at bank full discharge, while Gorman's methods uses an empirical relationship between stream power at bank full discharge and the bed granulometry. The data used in this project is principly raw and processed LiDAR and orthoimages. The bankfull level, and therefore the slope, is obtained by hydraulic simulation with HEC-RAS along the entire length of the river. Field data were collected to measure the median diameter of the granulometry (D50) on 5 Québec (Canada) rivers (Matane, Trinité, Sainte-Marguerite-Nord-Est, York and Les Escoumins) for a total of 118 sites for the calibration and the validation of the models. The presentation will compare the results obtained by the two models, according to the type of channel geomorphic units and the methods used to arrive at these results.

Affiliation

INRS

Presentation type

Oral

Epigenetic patterns in Atlantic herring (Clupea harengus): Temperature and photoperiod as environmental stressors during larval development

James Kho[1], M. Lisette Delgado[1], Gregory R. McCracken[1], Jenna Munden[1], Daniel E. Ruzzante[1]

[1]Dalhousie University

Knowledge on the molecular underpinning of environmental stress response can help improve our understanding of how organisms tolerate dynamic environmental fluctuations such as those experienced by marine species in the ocean. Atlantic herring (*Clupea harengus*) is a widely distributed coastal pelagic fish of ecological and economic importance that is susceptible to environmental changes caused by global warming. Temperature and photoperiod are two key environmental variables involved in the spawning time and location of adult herring, but not much is known about how these environmental variables influence the vulnerable early developmental stages at the molecular level. Here, the DNA methylation patterns of herring were examined during early developmental stages using a 2 x 2 factorial design with two temperature (11°C and 13°C) and photoperiod (6 and 12 h) treatments. High levels of global methylation were consistent across all individuals. A negative correlation between global methylation levels and increasing development stage was observed and more pronounced at 13°C ($p \leq 0.007$) than at 11°C ($p \geq 0.21$). Differentially methylated sites were mostly found in exon and promoter regions of genes associated with metabolism and development, and some of these regions were hypermethylated at 13°C. These results suggest that DNA methylation is a key element in the regulation of early-stage responses to environmental stress in this species and demonstrates the role of DNA methylation during Atlantic herring development.

Affiliation

Dalhousie University

Presentation type

Oral

Prevalence of Toxic Benthic Cyanobacteria in Shubenacadie Grand Lake

Yannan Huang[1], Lindsay Johnston[1], Lydia Zamlynny[1], Cecilio Valdez-Cano[2], Cheryl Rafuse[3], Janice Lawrence[2], Daniel Beach[3], Rob Jamieson[1], Hannah Morris[1]

[1]Dalhousie University, [2]University of New Brunswick, [3]Biotoxin Metrology, National Research Council, Halifax, NS

On June 9 of 2021, two dogs ingested mats of toxin producing benthic cyanobacteria, with anatoxin being the causative toxin, along the shoreline of Shubenacadie-Grand Lake, Nova Scotia and died shortly afterwards. Shubenacadie-Grand Lake is a large oligotrophic lake that receives inputs from many streams and smaller lakes. The lake system is heavily used for recreational activities, fishing, and drinking water, and is a highly valued ecosystem. An initial study conducted in 2022 focused on examining the prevalence, genetic characteristics, and toxicity of benthic cyanobacterial mats in a small stream and lakeshore located in the immediate area where the dogs ingested the toxic material. Toxin producing benthic cyanobacteria, specifically *Microcoleus*, was found to be proliferating both within the stream and the lakeshore where the stream entered the lake. In this presentation we will review these initial findings and results from a follow up study conducted in 2023 to assess if *Microcoleus* is more widely distributed throughout the lake system. In the spring of 2023, a total of 20 sampling locations were established throughout Shubenacadie-Grand Lake focused on tributary outlets and popular recreational areas, such as the Oakfield Provincial Park. LC-MS Total Anatoxin results from the 2023 sampling program revealed that toxin producing *Microcoleus* is present at several locations throughout the lake, not just within the stream and lakeshore area where the dog deaths occurred. These findings add to a growing body of knowledge demonstrating the wide distribution of *Microcoleus* within Atlantic Canadian surface waters.

Affiliation

Dalhousie University

Presentation type

Poster

Integrating Genomics and Telemetry: A Northern Cod Study

M. Lisette Delgado[1], Steve Devitt[2], Nicole Smith[3], Fred Whoriskey[1], Sara Iverson[1], Ian Bradbury[3], Paul Bentzen[1], Daniel E. Ruzzante[1]

[1]Dalhousie University, [2]Atlantic Groundfish Council, [3]Fisheries and Oceans Canada

Recent advances in genomics and telemetry have helped fill gaps in our understanding of the biology of fish stocks. Genomics has allowed the identification of genomic variation linked to physiological and behavioral traits as well as the identification of genetic groups at finer scales than previously possible. Telemetry, instead, provides information regarding individual movements, documenting a species' seasonal movement patterns and hence stock distribution. In Canada, the Northern Cod (*Gadus morhua*) complex which occupies the area off the east coast of Newfoundland and Labrador, historically supported critically important fisheries. Thirty years ago, the population collapsed, and subsequent management measures have had minimal success in restoring the complex. We combined genomics and telemetry in a study designed to better understand factors that may be hindering Northern cod population recovery. We sequenced ~300 tagged individuals using a low-coverage whole sequencing approach with the aim to associate genomic regions with migratory behavior. Preliminary telemetry analysis has revealed at least three types of individual movements: i) migratory individuals that moved among NAFO divisions (2J3KL), ii) individuals that remained within a single NAFO division, and iii) individuals that remained inshore year-round. At least two genomic regions (i.e., an inversion in chromosome 1 and a region in chromosome 18) have previously been linked to migratory behavior in NE Atlantic Cod. Our goal is to identify any direct association between the three types of movements and genomic regions. This research will help inform the restoration and future sustainable management of the Northern Cod complex.

Affiliation

Dalhousie University

Presentation type

Oral

A framework for understanding the impacts of permafrost thaw-driven disturbance regimes on northern lakes

Joshua Thienpont[1], Claire O'Hagan[1], John Smol[2], Steve Kokelj[3], Jennifer Korosi[1]

[1]York University, [2]Queen's University, [3]Northwest Territories Geological Survey

Permafrost thaw slump disturbances on aquatic ecosystems are intensifying across the Arctic due to anthropogenic climate change. For many Arctic landscapes, recent intensification of thaw slump activity has been associated with the re-initiation or growth of existing slumps, rather than initiation of new slumps. Our aim is to integrate existing knowledge, gain new perspectives, and inform future hypotheses by developing a conceptual model considering the impacts of shoreline thaw slumps on well-studied lakes in the Tuktoyaktuk Coastal Plains region (western Canadian Arctic). We compared regional changes in slump activity and lake water quality variables known to be impacted by slumping between 2005 and 2017 and showed that timelines to recovery in lake dissolved organic carbon following slump stabilization are longer than the time between cycles of slump growth, stabilization, and re-initiation in most lakes. We also analyzed geochemical changes in gravity sediment cores that incorporated the last several hundred years in 18 lakes that span a gradient in thaw slump disturbance, as well as a piston core dating back to ~1365 AD in a lake with an ancient slump. Results suggest that sediment geochemical changes are most pronounced at the initial onset of slumping, with only muted changes in sediment characteristics upon slump growth or re-initiation. The combined sediment core and regional lake survey results were used to develop a new conceptual model to guide future investigations into the extent to which lakes with recurring thaw slumps are predisposed to, or buffered against, significant limnological changes under anthropogenic climate warming.

Affiliation

York University

Presentation type

Oral

Decade of Dedication: Safeguarding Atlantic Salmon Through Strategic Protection of Cold-Water Refuges in a Changing Climate

Carole-Anne Gillis[1], Renaud Quilbé[1], Pascale Gosselin[1], Jean-Daniel Savard[2], Mireille Chalifour[3]

[1]Gespe'gewa'gi Institute of Natural Understanding, [2]Restigouche River Watershed Management Council, [3]Matapedia-Restigouche Watershed Organization

Prolonged low flow events, leading to elevated water temperatures, pose a growing challenge in eastern Canadian rivers. Amidst the climate change backdrop, thermal refuges emerge as critical sanctuaries for resilient Atlantic salmon populations. Cold-water refuge research in the Restigouche River watershed was initiated in 2010 and marked a proactive step towards ensuring the resilience and viability of freshwater salmon life stages. Our commitment to evidence-based decision-making continues to fuel diverse collaborative efforts aiming to bridge the gap between scientific understanding and actionable conservation strategies to safeguard Atlantic salmon habitats. Over the past decade, multiple initiatives dedicated to enhancing both connectivity and thermal quality within these critical habitats. This served as the foundation for a decision matrix tool, leveraging refuge types to assist managers in prioritizing efforts for the preservation, and enhancement. By delving into the detailed mapping of thermal refuge drainage areas, we aim to pinpoint catchment characteristics and identify land-use practices jeopardizing the cold-water persistence crucial for Atlantic salmon. This presentation offers a retrospective on more than ten years of regional commitment, illustrating the sustained efforts to safeguard and improve cold-water refuges as indispensable components of riverscapes grappling with the challenges imposed by a changing climate.

Affiliation

Gespe'gewa'gi Institute of Natural Understanding (GINU)

Presentation type

Oral

Multi-decadal marine growth profiles of Atlantic salmon in the North Atlantic

Cindy Breau[1], Gérald Chaput[1]

[1]Fisheries and Oceans Canada

Marine growth of Atlantic salmon (*Salmo salar*) is considered to be largely determined by bottom up drivers (prey quantity and quality, water temperature) whereas survival of salmon at sea is inferred to be dependent upon growth rates, accumulated energy reserves of individual fish, and predation. For some populations, growth rates in the first year at sea were found to differ between One-Sea-Winter (1SW) salmon and Two-Sea-Winter (2SW) salmon suggesting the sea age classes were distributed in different oceanic areas in their first year. Here, we use a 60 year (1958 to 2018) dataset of growth patterns on scales of Atlantic salmon from the Miramichi River (NB) to test two hypotheses: 1) 1SW and 2SW salmon from the same smolt migration year encounter similar growth conditions in the first year at sea until the point when the two life stages diverge; and 2) cumulative growth, up to the point of spatial divergence, is greater for 1SW than for 2SW salmon which relates to the maturation process. Our results show that marine growth profiles on scales are generally similar between 1SW and 2SW salmon, with some exceptional years, until the end of the first winter when the sea age classes diverge. There is no obvious size advantage of 1SW salmon in the first year. Variations in growth rates at sea cannot explain the declining trend in abundances of anadromous Atlantic salmon since the 1990s, suggesting that factors unrelated to growth may be the main drivers of survival at sea.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

Temporal dynamics and isolation of Microcoleus-infecting cyanophages in the Wolastoq| Saint John River, NB.

Janice Lawrence[1], Casey Leonard[1], Meghann Bruce[2], Cecilio Valdez-Cano[1], Adrian Reyes-Prieto[1]

[1]University of New Brunswick, [2]Canadian Rivers Institute

Some benthic cyanobacteria produce toxic secondary metabolites, such as anatoxins, that can have drastic consequences for wildlife, water quality, and those who use water bodies for recreation. To determine the seasonal prevalence of the *Microcoleus*-infecting phage in freshwater benthic mat communities and its influence over the population dynamics of potentially toxic cyanobacteria, 36 samples of interstitial water and cyanobacterial mats were collected from July-October 2022 along the shore of Eqpahak Island in the Saint John River|Wolastoq (WR). To investigate the presence of the phage in water samples, we used two approaches. First, a plaque assay was used to evaluate phage infectivity to 4 different toxic strains of *Microcoleus* sp. isolated from the WR. Then, we tried PCR amplification of a phage *tail fiber* gene to detect for phage DNA. To determine if the mats had the potential to produce anatoxins, a PCR assay was used to detect the *anaC* gene involved in the synthesis of the neurotoxin. Infectious phage were found in water samples collected in September, while phage DNA was detected in all water samples collected from July-October. Similarly, the *anaC* gene was detected in all mat samples from July-October. We also found that the 4 potentially toxic *Microcoleus* strains present varying levels of susceptibility to phage infection. From isolating infectious phages and determining their temporal dynamics, we can further study 1) what causes potentially toxic strains of *Microcoleus* to be susceptible to cyanophage infection, and 2) how phage infections impact the presence and abundance of benthic anatoxin-producing *Microcoleus*.

Affiliation

University of New Brunswick

Presentation type

Oral

Ecological legacy of past gold mining activities reflected by the benthos of Nova Scotian lakes

Branaavan Sivarajah[1], Josh Kurek[2], Suzan Mhagama[2], Jordan Takkiruq[2], Hanah Zettel[2], Jesse Vermaire[1]

[1]Carleton University, [2]Mount Allison University

Gold mining operations between ~1860 and 1940 have led to pollution of water, soil, and biota near to and downstream of many historical mines in Nova Scotia. We used geochemical proxies and benthic invertebrates from dated sediments to study recovery trajectories at impact and reference lakes. Probable Effects of Concentrations - Quotient (PEC-Q) exceeded thresholds during mining and continue to be elevated ~80 years afterwards. Sediment-dwelling biota have responded to the cumulative effects of mining contaminants and land-use changes. Surface runoff from tailing fields and climate-mediated changes also likely play a role in aquatic recovery. Our results contribute to understanding the complex legacy of human activities and highlight challenges to complete aquatic recovery in an ever-changing world.

Affiliation

Mount Allison University

Presentation type

Oral

Estuaries as hybrid systems with respect to nutrient limitation of algal growth: P-limitation to N-limitation along a salinity gradient

Annie Paulin[1], Alain Patoine[2]

[1]NB Department of Agriculture, Aquaculture and Fisheries, [2]Université de Moncton, Campus de Shippagan (UMCS)

Phytoplankton growth in freshwater environments is generally constrained by phosphorus (P) availability, while growth in coastal, saline environments is generally limited by nitrogen (N). "Hybrid" systems such as estuaries should thus display both types of algal biomass limitation: by phosphorus at upstream, freshwater sites, and by nitrogen at downstream, saline sites. The pattern has previously been observed, but only for heavily populated estuarine watersheds with N to P ratios influenced by wastewater discharges, and over distances that stretched over 100 km. Here, we examine P to N limitation shifts over smaller distances (5-14 km) in a set of coastal catchments with relatively low human occupation. Four coastal watersheds were sampled over three years, in spring and summer, each one at a freshwater upstream station and a brackish downstream station. We conducted bottle nutrient addition experiments during which *in vivo* chlorophyll *a* was monitored. Algal growth stimulation by P addition decreased from upstream to downstream stations, along an increasing salinity gradient, while the inverse pattern was observed for growth stimulation by nitrogen addition. Where present, wastewater point sources were not sufficiently important to impact on experimental nutrient addition results. In contrast, highest P-limitation was observed at a station with slow moving waters, possibly making it behave more like a lacustrine system than a riverine system. Algal community composition differed between up- and downstream sites, despite some overlap. Our results show that the shift between P limitation (upstream) and N limitation (downstream) can occur on much smaller spatial scales than previously reported.

Affiliation

Université de Moncton, Campus de Shippagan (UMCS)

Presentation type

Poster

Detecting shared trends and synchronicity in freshwater and marine Sockeye salmon productivity

Colin Bailey[1], Cameron Freshwater[1]

[1]Fisheries and Oceans Canada

When the average Canadian thinks of Pacific salmon, they think of sockeye salmon. Known for bright spawning colours and their formerly immense numbers, now BC sockeye salmon frequently appear in the news for other reasons - stock crashes, mass pre-spawn mortality, migration blockages, and low marine survival. Despite public attention, court inquiries, and decades of research, we still have a poor understanding of what drives sockeye salmon productivity, particularly because freshwater and marine productivity are commonly confounded. Here, I present our attempt to tackle this issue using Multivariate Auto-Regressive State-Space (MARSS) models leveraging timeseries of freshwater and marine productivity from 12 sockeye salmon populations from northern British Columbia to the Columbia River basin. Using shared trends in life stage-specific productivity produced from MARSS models, we asked 1) Are there shared trends in productivity among Sockeye Salmon populations that shed light on the drivers of productivity? 2) Are shared trends in marine productivity more or less synchronous than trends in freshwater productivity? 3) Is there synchronicity between freshwater and marine productivity? To date, we have learned that Sockeye Salmon productivity trends in both freshwater and marine environments appear to group by natal watershed (e.g., Fraser, Columbia, etc.). Our results suggest that the processes with the greatest impact on Sockeye Salmon productivity are occurring in the lower reaches of watersheds, in estuaries, and in nearshore marine migration locations. Future work will address questions 2 and 3, which will help us determine how drivers of productivity may be shared between freshwater and marine environments.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

Spatio-temporal analysis of suspended sediments in six estuaries in Atlantic Canada

Estuaries are important habitats for aquatic flora and fauna. One crucial factor that can affect the biomass of these environments is suspended sediment concentration (SSC). The lack of historical in situ data, coupled with the lack of spatial coverage, means that the spatio-temporal variability of SSC is difficult to assess. A three-step methodology will be presented. Firstly, satellite data will be used to create the data history required for this study. By combining these data with in situ data, it will become possible to assess their correlation, thereby providing partial ground truthing. Six estuaries in Atlantic Canada have been monitored during two ice-free seasons, each equipped with a turbidity meter sampling hourly. They have been calibrated against spot measurements of suspended sediment concentrations. In addition to the hourly time series provided by turbidity meters, spot turbidity measurements were taken in five of the six estuaries at separate locations and tidal stages to partially assess spatial variability. These in situ data will be used to calibrate and validate the algorithm used to convert satellite data to SSC. It will therefore be possible to build historical time series spanning several years. Using this database, a time series will be constructed. Different sections of the estuaries will be analyzed separately. It will therefore be possible to understand both spatial and temporal variability. Finally, candidate predictor variables, such as rainfall, discharge, tides and wind, will be analyzed in conjunction with the SSC data. Preliminary results will also be presented.

Affiliation

INRS

Presentation type

Oral

Open data in action: advancing community-driven freshwater protection with DataStream

Community-based monitoring programs (CBM) have long played a key role in freshwater protection across Canada. CBM initiatives facilitate public engagement in water stewardship and collect vital data needed to track and understand watershed health. Bringing together these massive amounts of data can provide the necessary temporal and spatial coverage needed to pinpoint significant environmental events, identify water quality trends, and make freshwater decisions with greater certainty. However, connecting data collected by diverse monitoring programs in a consistent, reusable format can often be challenging, costly, and time-consuming. Open-access tools like DataStream are transforming how water data can be shared for environmental research and informed decision making. Designed with communities, researchers, and decision-makers in mind, DataStream is an open-access platform for sharing water and sediment quality data in accessible, standardized, and analysis-ready formats. Today, DataStream's open data platform provides access to over 35 million unique, standardized water quality observations published by more than 250 monitoring organizations in four hub regions across Canada. In this presentation, we will share examples of how open-access data is being used to strengthen community-driven freshwater stewardship and contribute to achieving habitat and biodiversity goals within, between, and across watersheds and jurisdictions.

Affiliation

DataStream

Presentation type

Oral

Identification of potential neurotoxic compounds in cyanobacterial exudates by metabolomics, machine learning, and molecular docking

Yuanyan Zi[1], Justin Barker[1], Jinmei Zi[2], Xuexiu Chang[3]

[1]University of Windsor, [2]Kunming University (China), [3]University of Windsor / Kunming University (China)

Cyanobacterial secondary metabolites may cause animal toxicity. *Microcystis aeruginosa*, the dominant species in global freshwater cyanobacterial blooms, produces exudates that cause adverse outcomes, including nerve damage. It is important to identify specific neurotoxic compounds produced by *M. aeruginosa*, though this can prove challenging owing to the complexity of exudate mixtures. In this study, we used untargeted metabolomics to compare components of exudates from two *M. aeruginosa* strains: a microcystin (MC)-producing strain (CPCC300) and a non-MC-producing (CPCC633) strain. We identified 1166 chemicals and found that the strains produced similar components, mainly organoheterocyclic compounds, organic acids and derivatives, henylpropanoids and polyketides, benzenoids, and lipids and lipid-like molecules. We then used Gradient Boosting Classifiers based on neurotoxicity assays, and binding affinities using molecular docking to screen for potential neurotoxic compounds among the compounds. We identified nine neurotoxic molecules that can inhibit activity of neurotransmitter receptors or which disrupted neurotransmission, including endoxifen O-glucuronide, ketoconazole, 2-trans-Hydroxycyclohexyl glyburide, mandipropamid, and cyanidin 3-(6-p-caffeoyl) glucoside. Our study enhances understanding of neurotoxicity mechanisms and identifies potential neurotoxins in cyanobacterial bloom exudates, which may help identify priority compounds for future management.

Affiliation

University of Windsor

Presentation type

Oral

Detecting sea lamprey attacks on lake trout with biologging tags

Connor Reeve[1], Scott Miehls[2], Michael Lowe[2], Jacob Brownscombe[3], Mary Moser[4], Steven Cooke[1]

[1]Carleton University, [2]USGS Hammond Bay Biological Station, [3]Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada, [4]NOAA National Marine Fisheries Service

Sea lamprey (*Petromyzon marinus*) remain problematic to lake trout (*Salvelinus namaycush*) restoration in the Laurentian Great Lakes. Fisheries assessments would benefit from knowledge of spatial-temporal patterns of parasitism; however, estimates can only be derived from sea lamprey wounding rates in collected lake trout which is an inadequate predictor of mortality. Direct field observations are needed to better assess sea lamprey attack rates and attack lethality in wild lake trout. Implantable tags that remotely measure fish behaviour and physiology may be useful in detecting sea lamprey attachments. Therefore, we implanted lake trout with biologgers that record heart rate and/or acceleration then observed responses to sea lamprey attachment. Random forests models (classification trees) were fit to predict sea lamprey attachment, with which the best predictors were related to body orientation and heart rate. After temporal prediction averaging, models predicted lamprey attachments with high accuracy; however individual-level jack-knifing resulted in less accurate cross-individual prediction and regularly predicted false-negatives. These findings may be related to individual variance in response to attachment, but there was also evidence of shifting tags post-implantation that likely impacted predictive performance and could be remedied with adjustments to surgical methods. Once improved, biologgers and related attachment algorithms could generate field-based estimates of sea lamprey attack and lethality rates in lake trout.

Affiliation

Carleton University

Presentation type

Oral

Classifying agricultural drains using fish communities: Comparison of conventional and eDNA methods

Markelle Morphet[1], Alex Van Nynatten[1], Nicholas Mandrak[1]

[1]University of Toronto Scarborough

Agricultural drains are ubiquitous in southwestern Ontario. When their function has been deemed to be impacted by erosion, sedimentation and over-growth, drains are dredged. However, these waterways are habitat for numerous fish species and are thereby protected under the Canadian *Fisheries Act* and, in some cases, the Canadian *Species at Risk Act*. To guide drain management practices, Fisheries and Oceans Canada (DFO) classifies agricultural drains based on permanency of flow, temperature, and presence of sensitive fish species. Their current fish sampling methods include seining, dipnetting, and electrofishing, all of which can be time and labour intensive. Given its comparatively low cost and sensitivity, environmental DNA (eDNA) sampling may be a more effective method to detect fishes in these drains. By comparing fish communities detected by eDNA metabarcoding and conventional sampling gear at 43 sites in 15 drains in southwestern Ontario, this study aims to determine the more efficient method to identify sensitive species and classify agricultural drains.

Affiliation

University of Toronto Scarborough

Presentation type

Oral

Behavioural responses to transport stress in threatened Eastern Sand Darter (Ammocrypta pellucida): a comparison of release methods for informing reintroduction strategies

Adam Gouge[1], Andrew Drake[2], Trevor Pitcher[3], Christine Madliger[1]

[1]Algoma University, [2]Fisheries and Oceans Canada, [3]University of Windsor

Reintroduction is becoming an increasingly important component of the conservation and rehabilitation of aquatic species. The reintroduction process can introduce a series of stressors for fishes including capture, handling, transport, and release into a novel environment. The transport segment of reintroduction procedures has been comparatively understudied, but has the potential to disproportionately affect the survival and establishment of released individuals due to its effects on behaviour and physiology. Specifically, the cumulative stressors associated with transport may negatively impact the ability of released fish to orient, find food resources, and evade predators. The traditional method of hard release involves releasing individuals immediately following transport. An alternative strategy of soft release involves temporarily holding individuals in an enclosure within the reintroduction site, providing them the opportunity to acclimate to their environment and recover from the transport event. Using open field tests, we assessed multiple ecologically-relevant behavioural endpoints of Eastern Sand Darter (*Ammocrypta pellucida*) that were exposed to simulated hard or soft release protocols following transport, as well as non-transported fish. We will present results on the influence of transport and release methodologies on activity level, space use, risk-taking behaviour, and neophobia. Our results will illuminate whether soft release methods can help reduce or mitigate the behavioural effects of transport stress. We aim to help guide the development of effective reintroduction protocols for Eastern Sand Darter in Ontario, as well as provide valuable information for consideration in protocols for other small-bodied, at-risk fishes.

Affiliation

Algoma University

Presentation type

Poster

Development of a policy for the protection and enhancement of cold-water refuges in the Restigouche River Watershed

Renaud Quilbé[1], Jean-Daniel Savard[1], Carole-Anne Gillis[2]

[1]RRWMC, [2]GINU

Over the last decade, there have been significant strides in comprehending thermal regimes, particularly in the realm of cold-water refuges (CWRs), recognized as pivotal facets of thermal heterogeneity. However, policy evolution has lagged behind these scientific advancements. The intricate and fluid nature of CWRs poses challenges in identification, measurement, protection, and management, necessitating an interdisciplinary and collaborative effort involving scientists, managers, communities, land-use planners, and policymakers.

In response to this gap, we advocate for a science-driven, long-term, watershed-scale strategy for CWR management in the Restigouche River watershed. The foundational step involves the formulation of a policy with objectives aimed at guiding the protection and maintenance of CWRs, specifically targeting riparian zones, headwater streams, and sub-watershed land use. Additionally, the policy promotes the creation or enhancement of CWRs, along with initiatives for protection, stewardship, education, awareness, and further research to deepen our understanding of thermal quality for salmonids.

The proposed policy encompasses both broad provincial recommendations and specific tools, including a methodological framework tailored for the selection, protection, and enhancement of CWRs. Currently underway as a pilot project in the Restigouche River watershed, this approach signifies a proactive stride towards effective CWR management. This presentation will provide an overview of the policy, with a focused exploration of key elements, elucidating its potential impact on holistic watershed management practices to preserve thermal quality in a changing climate.

Affiliation

RRWMC

Presentation type

Oral

Prevalence of Toxin Producing Microcoleus in Nova Scotia Lakes and Rivers

Yannan Huang[1], Cecilio Valadez-Cano[2], Lindsay Johnston[1], Hannah Morris[1], Lydia Zamlynny[3], Daniel Beach[3], Janice Lawrence[2], Rob Jamieson[1]

[1]Dalhousie University , [2]University of New Brunswick , [3]The National Research Council

Benthic cyanobacteria can produce highly potent toxins, most notably anatoxins, but are far less studied than their planktonic counterparts. In June 2021, two dogs died after ingesting benthic cyanobacterial mats from the shoreline of Shubenacadie Grand Lake near Halifax, Nova Scotia (NS). *Microcoleus spp*. were implicated in these deaths. A research program was initiated in 2022 to better understand how prevalent these cyanobacteria are in NS surface waters. Two key research questions were asked: (i) are the *Microcoleus* strains found in NS genetically similar to those discovered in other regions, and (ii) what is the prevalence of toxigenic *Microcoleus* strains in NS surface waters. Preliminary surveys identified *Microcoleus* within a diverse range of river and lake systems in NS. A combination of next-generation sequencing, including PacBio 16S and metagenomics, qPCR toxin gene assays, and LC-MS toxin analysis were used to characterize the microbial community composition and toxin levels in these systems. Preliminary sequencing results show that both toxic and non-toxic *Microcoleus* strains co-exist within NS surface waters. Some toxin-producing strains are closely related to those found in the Wolastoq, New Brunswick, however, novel toxin-producing strains have also been recovered. Toxin and *anaC* gene concentrations vary widely depending on the presence and relative abundance of toxin-producing *Microcoleus* strains. In conclusion, *Microcoleu*s can proliferate in different types of freshwater environments in NS, with specific strains capable of producing elevated levels of anatoxins.

Affiliation

Dalhousie University

Presentation type

Oral

Naked and Afraid? Th thermal tolerances of five Ammocrypta species

Britney Firth[1], Abbey Holsopple[2], Bernie Kuhajda[2], Anna George[2], Andrew Drake[3], Michael Power[1]

[1]University of Waterloo, [2]Tennessee Aquarium Conservation Institute, [3]Fisheries and Oceans Canada

Thermal tolerance is a species specific attribute and may vary significantly within a genus. In this study, we assessed the interspecific variation of thermal tolerance (CT_{max}) and agitation temperature (T_{ag}) among five of six *Ammocrypta* species, small benthic fishes all currently listed as at-risk in part of their geographic ranges. Field based CT_{max} trials were conducted stream-side across seasons (April-August 2019 and 2023) to encompass a range of ambient water temperatures (12-28 °C). Thermal tolerance significantly increased with increasing ambient water temperature for all species and there were significant among species differences in tolerances. As species diverge, thermal tolerance becomes significantly different, with the first species, Eastern Sand Darter, having a higher thermal tolerance (35℃) compared to the last two species, Naked and Florida Sand Darter (33.5℃). Additionally, Naked and Florida Sand Darter had the smallest thermal safety margins (difference between ambient temperatures and CT_{max}; 11.8℃), indicating that these species are living closer to their physiological limits and are most at risk under predicted climate change scenarios. Reasons for the among species variation are unknown, but may include: latitudinal differences in geographic range, range size, and water temperature variability all of which may have driven reduced thermal tolerance as species in the *Ammocrypta* genus diverged. Overall, study results provide a better understanding of thermal tolerance differences within the *Ammocrypta* genus and underline the need for estimates of species-specific tolerances for conservation-based decisions regarding species specific capacities to withstand climate change.

Presentation type

Poster

Thermal tolerance of wild and lab acclimated Rainbow Darter and Striped Shiner

Britney Firth[1], Paul Craig[1], Michael Power[1]

[1]University of Waterloo

Assessing thermal tolerance is a fundamental conservation physiology tool for understanding habitat requirements, site suitability, and providing key information on how well species may withstand future increases in water temperature. However, thermal tolerances measured in laboratories at constant temperatures can be significantly different than thermal tolerances measured in the wild under a regime of fluctuating temperatures. We assessed thermal tolerance (CT_{max}), hematocrit, and metabolic enzyme activity of Rainbow Darter (*Etheostoma caeruleum*) and Striped Shiner (*Luxilus chrysocephalus*) stream-side in the wild and after one-month lab acclimation. Rainbow Darter had significantly higher thermal tolerance in the wild (30.99℃ ± 0.19) than in the lab (28.28℃ ± 0.61). In contrast, Striped Shiner had significantly lower thermal tolerance in the wild (24.84℃ ± 1.08) than in the lab (28.48℃ ± 0.44). Hematocrit percentage did not change for either species. Brain and muscle tissue was collected to assess metabolic enzyme activity. Our findings demonstrate that measurement of thermal tolerance in the lab can lead to significant positive or negative bias with respect to field-based measures, raising the question of the implications of the differences for the development of effective conservation management guidelines and practices. Furthermore, as we cannot generalize a pattern in the differences between field and lab measurements, we need to estimate tolerances for a wider variety of species.

Affiliation

University of Waterloo

Presentation type

Oral

Improving Selectivity in Multiclass Cyanotoxin Analysis Using Multi-Stage Tandem Mass Spectrometry

Daniel Beach[1], Rob Jamieson[2], Lydia Zamlynny[2]

[1]Biotoxin Metrology, National Research Council of Canada, 1411 Oxford St. Halifax, NS, [2]Dalhousie University, 6299 South St. Halifax, NS

Cyanobacteria are prokaryotic organisms that can form harmful blooms, have significant ecological impacts and produce toxic secondary metabolites called cyanotoxins. These toxins pose a significant public health risk as they have been found to cause illness and sometimes even death, impacting both humans and animals worldwide. Recently, in Atlantic Canada, there have been several incidents of animal fatalities linked to one class of cyanotoxins, anatoxins, including the deaths of three dogs in July 2018 (Wolastoq, Fredericton, NB) and two dogs in July 2021 (Shubenacadie-Grand Lake, NS). However, comprehensive analysis of all classes of cyanotoxin classes (e.g. microcystins, anatoxins, cylindrospermopsins) poses several challenges including varying chemical properties and the large number of structural analogues. Integration of anatoxins into multiclass methods is particularly difficult due to their small size and high spectral background at low *m/z* with typical LC-MS methods. Here, we present a new multiclass LC-MS method with improved selectivity to be used for routine analysis to investigate the prevalence of cyanotoxins in Nova Scotia surface waters. This method takes advantage of a tandem MS^3 scan mode on a QTRAP mass spectrometer with higher selectivity than typical triple quadrupole methods. This helps to minimize spectral background and therefore make quantitation of low mass compounds like anatoxins more accurate for complex samples. This method will be applied to field samples collected from across Nova Scotia to study toxin prevalence and risk factors in the province and help with the development of toxin guidelines for public health protection.

Affiliation

Dalhousie University, 6299 South St. Halifax, NS

Presentation type

Poster

Changes in size-at-age of juvenile Atlantic salmon over the past 50 years and linkages to environmental factors

Jean-Michel Matte[1], Guillaume Dauphin[2], André St-Hilaire[1], Carole-Anne Gillis[3], Normand Bergeron[1], Cindy Breau[2]

[1]Institut national de la recherche scientifique, [2]Fisheries and Oceans Canada, [3]Gespe'gewa'gi Institute of Natural Understanding

Atlantic salmon populations are facing an increasing number of threats related to climate change. Climate warming is known to affect somatic growth in fishes; For juvenile salmonids, somatic growth is critical as it is one of the factors determining the timing to transition from fresh water to the marine environment. Predictions are that climate change will lead to changes in somatic growth which will cumulate throughout the years spent in freshwater for any given cohort. However, quantifying such potential effects on growth in natural systems is challenging given that long-term dataset are required (i.e. multiple decades), and that several spatio-temporal biases must be accounted for. In the present work, we developed a novel model implemented in a Bayesian framework to quantify the effects of water temperature metrics and fish density on size-at-age of juvenile cohorts of Atlantic salmon. The study used data collected in the Miramichi and Restigouche rivers, in Eastern Canada, over a period of ~50 years (1970 - 2021). Results demonstrate important variability in size-at-age within and between rivers. The within-river variability was correlated to water temperature and fish density at the sub-catchment level. This within-population variability and the predicted future climate warming have important implications for these populations and their management in the context of rapidly changing freshwater environments.

Affiliation

Institut national de la recherche scientifique

Presentation type

Oral

Microplastics in surface waters from Great Slave Lake and the Mackenzie River, Northwest Territories

Madelaine Bourdages[1], Jennifer Provencher[2], Jesse Vermaire[1]

[1]Carleton University, [2]Environment and Climate Change Canada

Microplastics are pervasive and persistent in the environment, however, understanding the sources, distribution, and fate of microplastics within freshwater systems requires further investigation. Microplastics have been identified in Arctic marine environments, but very little remains known about microplastics in Arctic freshwater systems. Given the importance of freshwater systems to the health of northern communities and ecosystems, and their large input of water to the Arctic Ocean, circumpolar rivers and lakes should be considered within the context of microplastics in the region. In summers of 2021 and 2022, surface water samples were collected using a 300 µm Manta trawl from Yellowknife Bay and the Yellowknife River (n = 30), the Slave River and Fort Resolution Bay (n = 11), the Mackenzie River near Fort Providence (n = 10), Inuvik (n = 11), and Tuktoyaktuk, and from the Beaufort Sea near Tuktoyaktuk (n = 8). Sample collections were conducted via a collaborative community-based approach. Preliminary data indicate the presence of microplastics in all sampling areas, with mean concentrations of suspected anthropogenic particles ranging from 0.25-0.61 particles m^{-3}.

Affiliation

Carleton University

Presentation type

Oral

Quantitative Investigations of Fishery Catch-Effort Relationships

Effective fishery stock assessments require an accurate representation of the relationship between fisherman catch and fishing effort. Though a direct proportionality between catch and effort is commonly assumed, this relationship has received little explicit attention in the literature. Using empirical dynamic modeling, we analyzed over 150 fishery catch and effort time series. These series were globally expansive and varied in spatial and temporal scale, fishery and gear type, and length. Of these series, we found that well over half demonstrated significant nonlinearity in catch, effort, or both. Significant causal influences between catch and effort were identified with convergent cross-mapping in 20 of these series. A bidirectional causal relationship was most common, though unidirectional influences in either direction were also observed. Where bidirectional relationships were detected, causal influences from catch to effort were generally stronger than those in the opposite direction. Widespread nonlinearity in catch and effort timeseries as well as observed variability in identifiable catch-effort relationships both imply that catch-effort relationships vary by fishery and often are more complicated than direct proportionality. Unaccounted for violations of this assumed proportionality could lead to biases in the abundance indices derived from these measures, complicating stock assessments. Acknowledgement of nonlinear dynamics within fisheries systems as well as more fishery-specific representations of the catch-effort relationship may help to improve the accuracy of abundance indices and fisheries assessment models.

Presentation type

Poster

A Two-Eyed seeing Approach to Enhance Gumegwsis (Common Lumpfish) Life History knowledge in inner Mawipoqtapei

M'sɨt No'gmaq[1], Ugpi'ganjig Gespe'gewa'gi[2], Carole-Anne Gillis[3], Billie Chiasson[3], Catherine Alexandra Gagnon[3], Pascale Gosselin[3], John M. Vicaire[3]

[1]M'sɨt No'gmaq, [2]Ugpi'ganjig, [3]Gespe'gewa'gi Institute of Natural Understanding

The integration of diverse knowledge systems, including Indigenous, local, and Western knowledge, is an increasingly adopted approach in scientific research and resource management. Despite successes in co-management methods, skepticism among scientists and decision-makers persists, leaving unaddressed gaps. In response to concerns voiced by Ugpi'ganjiq fishers regarding a specific fish species, GINU initiated a collaborative project with the community. During a literature review, it was discovered that even the COSEWIC assessment solely relied on Western viewpoints, asserting, "There are no indications of any ceremonial uses of Lumpfish in Canada and there is no ATK (Aboriginal Traditional Knowledge) information available." In contrast, the Mi'gmaq community referred to the species as Gumegwsis, revealing their distinctive relationship and comprehension of it. To bridge this gap, GINU implemented a Two-eyed seeing approach. This holistic approach allowed us to comprehensively describe Gumegwsis life history in inner Mawipoqtapei, its significance to local fishers, and informed decision-making for its protection, thereby enhancing species recovery. Our endeavors underscore the significance of embracing multiple knowledge systems in deciphering species ecology and critical habitats, presenting a compelling case for the enhancement of dialogue and collaboration in fisheries research.

Affiliation

Gespe'gewa'gi Institute of Natural Understanding

Presentation type

Oral

Effects of boreal and hemiboreal forest harvest on freshwater salmonid habitat

Boreal and hemiboreal forests support freshwater habitats for a diversity of salmonid fishes - a group of taxa with considerable ecological, socio-economic, and cultural value - by influencing food availability, physical habitat structure, and water temperature, flow, and chemistry. However, these forested landscapes have changed substantially over the last two centuries from industrial forest harvesting activities including wide-spread canopy removal and road building. A global quantitative synthesis into the effects of forest harvesting on salmonids, in boreal and hemiboreal forest regions, has never been undertaken, nor have the pathways of effects between forestry activities and impacts on salmonid habitat been definitively established. I conduct a systematic review and meta-analysis to answer the questions: (1) what is known about the effects of the extent, duration, and intensity of forest harvesting on freshwater salmonid habitats in boreal and hemiboreal ecosystems globally? and (2) how might techniques in evidence synthesis be used to harmonize and compare results of existing studies across methodological approaches, site and treatment conditions, and regions? I will compile a database of studies representing forest harvesting effects on over a dozen salmonid fish species native to boreal and hemiboreal forests. Using a multilevel meta-analytic modelling framework, I will derive insights into key pathways of effects to salmonid habitats and how the magnitude of these effects vary across space and time. These results will enable broad inferences to inform forest harvest planning in boreal and hemiboreal forest regions to better conserve and manage freshwater salmonid habitats.

Affiliation

School for Resource and Environmental Studies, Dalhousie University

Presentation type

Oral

Assessing juvenile American eel (Anguilla rostrata) migration patterns in the lower Wolastoq | Saint John River

Felix Eissenhauer[1], Thomas Pratt[2], R. Allen Curry[1], Tommi Linnansaari[1], Philip Harrison[1]

[1]UNB, [2]DFO

Juvenile eels arrive from the spawning grounds in the Sargasso Sea and enter estuaries along the eastern shoreline of the North Atlantic Ocean in winter and spring of their first year of life. The large number of arriving recruits into abundance-saturated areas leads to a density-dependent upstream migration of juvenile eels. We studied the upstream migration of juvenile eels in the lower Wolastoq | Saint John River, focussing on length-age relationship in different river sections and timing of migration. For two years multiple sampling sites along the lower Wolastoq | Saint John River between the river mouth in Saint John and the eel migration barrier at the Mactaquac Dam were sampled with fyke nets. Captured eels were measured in length and subsamples were collected for age determination through otolith readings. We observed an increasing body size and age of migrating juvenile eels as they moved farther from the sea, with eels taking up to three years to ascend to the Mactaquac Dam. Furthermore, we examined a shift away from the utilization of near shore substrate layers as migration pathways with increasing distance from the sea. These results inform about the duration of eel upstream migration in a large tidal and hydropower regulated river and provide insights into the coping mechanisms of migrating juvenile eels with dams and hydropeaking. This will be of high importance for conservation measures and fisheries management of this endangered fish species.

Affiliation

University of New Brunswick, Canadian Rivers Institute

Presentation type

Oral

Impacts of warming waters and predation risk on minnow behaviour and thermal tolerance

Veronica Groves[1], Lauren Chapman[1]

[1]McGill University

Anthropogenic stressors are increasingly threatening the health and biodiversity of freshwater systems. These, stressors rarely exist in isolation; and thus, it has become critical to evaluate the effects of multiple stressors on aquatic organisms. One example is the potential interaction between warming waters and increased predation pressure due to range-shifting or invading piscivores. The goal of this study was to examine the interactive effects of predation risk and elevated water temperature on the behaviour and thermal tolerance of the prey minnow: Blackchin Shiner (*Miniellus heterodon*). Shoals of Blackchin Shiner were acclimated to either 18 °C or 25 °C conditions for several months after which they were exposed to 4 weeks of high or low predation risk using chemical risk cues (predator odor) or a water control. Behavioural observations were conducted to evaluate anti-predator behaviours. Then, we quantified upper thermal tolerance (critical thermal maximum, CTmax) three times: 1) post long-term exposure to risk; 2) during acute exposure to predator odor and; 3) during acute exposure to conspecific disturbance cue. We found that antipredator responses of Blackchin Shiner to predator odor decreased over time in the high-risk groups demonstrating threat-sensitive predator avoidance by shrinking the 'memory window'. We also found that acclimation to 25 °C significantly increased CTmax demonstrating acclimation capacity in this species. However, acute exposure to disturbance cue increased CTmax in 18 °C fish, but not 25 °C fish. Taken together, our findings demonstrate behavioural and physiological plasticity of prey fish in response to increased temperature and predation risk.

Affiliation

McGill University

Presentation type

Oral

A Test of Intersexual Trophic Niche Partitioning Within a Population of Wood Turtles, Glyptemys insculpta

Brian Hayden[1], Christopher Edge[2], Bobby Nakamoto[1], Damien Mullin[2, 3], Jesse Bellamy[1, 2]

[1]Canadian Rivers Institute, Biology Department, University of New Brunswick, Fredericton, [2]Canadian Forest Service, Natural Resources Canada, [3]Forestry and Environmental Management Department, University of New Brunswick, Fredericton

Wood Turtles (*Glyptemys insculpta*) are a semi-aquatic turtle species that have been known to exhibit intersexual variation in habitat use in the summer. Males often remain near watercourses in riparian areas, whereas females tend to move upland and spend more time in terrestrial environments post-nesting. Dietary niche partitioning is one of several hypotheses proposed to explain this phenomenon, as females could be leaving aquatic habitats in search of terrestrial food resources. The presence of dietary niche partitioning within a population of Wood Turtles in central New Brunswick was assessed using stable isotope analysis. Male and female Wood Turtles were sampled in the spring and summer of 2021. Potential invertebrate food sources were sampled and grouped into pond, stream, and terrestrial food sources. Using stable carbon ($d^{13}C$) and nitrogen ($d^{15}N$) isotopic ratios of extracted red blood corpuscle and blood plasma, the resource use and isotopic niche widths of individuals within the population were compared between seasons and sexes. Results indicated that no significant differences in $d^{13}C$ and $d^{15}N$ values, dietary contributions, or isotopic niche widths between spring and summer samples or between males and females. We determined that terrestrial invertebrates were an important food source (>72% mean diet contribution) across the entire sampled population, with the invasive *Arion* slug species constituting a large portion of turtle's diet. Our findings indicate that dietary niche partitioning is most likely not in the explanation for sexual variation in habitat use by Wood Turtles.

Affiliation

Canadian Rivers Institute, Biology Department, University of New Brunswick, Fredericton

Presentation type

Poster

Secondary production in agro-landscapes: an ecosystem service approach to linking aquatic and terrestrial ecosystems

Natalie Rideout[1], Niloofar Alavi[2, 3], David Lapen[4], Gregory Mitchell[5, 6], Wendy Monk[1], Donald Baird[1]

[1]Environment and Climate Change Canada @ Canadian Rivers Institute, Department of Biology, University of New Brunswick, Fredericton, NB, Canada, [2]Landscape Science and Technology Directorate, Environment and Climate Change Canada, 1125 Colonel By Rd., Ottawa, ON, K1A 0H3, Canada , [3]Department of Geography and Environmental Studies, Carleton University, 1125 Colonel By Rd., Ottawa, ON, K1A 0H3, Canada , [4]Ottawa Research Development Centre, Agriculture and Agri-Food Canada, Ottawa, ON, Canada, [5]Wildlife Research Division, Environment and Climate Change Canada, 1125 Colonel By Rd., Ottawa,ON, K1A 0H3, Canada , [6]Department of Biology, Carleton University, 1125 Colonel By Dr., Ottawa, ON, K1S 5B6, Canada

In anthropogenically-dominated landscapes, such as agricultural systems, drainage ditches and streams can serve as havens for biodiversity, including riparian bird communities. Aerial insectivores—currently experiencing global declines—nest and forage in these drainage ditch networks, relying on emerging aquatic insects, not only as an energy supply, but as a nutritionally-critical component of their diet. Ditches, however, are designed for utility, helping farm operators control water levels on their fields, and as such are subjected to multiple stressors. These can include direct runoff and drainage from fields, which can include an array of agro-chemicals, along with agricultural water extraction, storage behind dams, diversions, dredging and clearing of riparian vegetation, which can impact the hydrology and ecology of ditch ecosystems. We quantify the value of ditch habitats in terms of aquatic insect production across a drainage ditch network in South Nation river basin, an agriculturally-dominated catchment of the Ottawa River watershed in eastern Canada. We ask how agricultural management influences the relationship between emerging aquatic insects and riparian birds. This research combines ‘green’ (terrestrial) and ‘blue’ (aquatic) biodiversity by examining landscape and in-stream variables and linking distribution of aquatic biota to terrestrial consumers. Our work is part of Environmental Change Onehealth Observatory (ECO^2), a Canadian federal interdepartmental project to study the consequences of erosion of natural capital and associated ecosystem services with the aim to find a balance between producing food and other commodities which support the well-being of Canadians with the need to provide increased biosphere stewardship.

Affiliation

Canadian Rivers Institute @ University of New Brunswick

Presentation type

Oral

Using coarse- and fine-scale passive acoustic telemetry to evaluate movement patterns and habitat use of a subarctic demersal gadid species in coastal Newfoundland, Canada

Movement, a fundamental component of animal ecology, reflects a balance of competing extrinsic and intrinsic factors that individual organisms must optimize to survive. Northern marine ecosystems are experiencing changes in ocean conditions that alter habitats, motivating investigations on links between species' movement patterns and responses to environmental fluctuation. Greenland cod (*Gadus macrocephalus ogac*) - a species ubiquitous to subarctic and Arctic ecosystems - largely resides in coastal environments. The widespread distribution and residential behaviour of Greenland cod uniquely position the species as a representative demersal fish that must withstand changing conditions in coastal habitats. Over a two-year period, we used passive acoustic telemetry within a fjord in Newfoundland, Canada to investigate Greenland cod movement at scales of meters to kilometers. We concurrently deployed towed video cameras to map habitats and baited video cameras to identify temporal variation in biotic communities across habitats. We used this combination of technologies to resolve Greenland cod spatial use patterns and habitat associations in relation to seasonal changes in environmental conditions. On a coarse spatial scale, we demonstrate that Greenland cod move widely through inner and outer fjord habitats throughout the year. On a finer spatial scale, we show that changes in thermal conditions may influence space use across depths. Preliminary analyses suggest that Greenland cod have unique movement behaviours relative to habitat types and show temporal differences in habitat use. Our study highlights the dynamic nature of fish movement and illustrates how local environmental conditions influence fish behaviour within a coastal marine habitat.

Affiliation

Memorial University of Newfoundland and Labrador

Presentation type

Oral

Linking declining Atlantic salmon (Salmo salar) populations with multidecadal changes in their marine foraging ecology

Atlantic salmon (*Salmo salar*) populations have declined considerably over the last 50 years to the point where many populations are now threatened or endangered. This decline is believed to be largely attributed to low marine survival caused (in part) by changes in ocean temperature and prey abundance. To date however, research has focused heavily on the freshwater portion of the Atlantic salmon lifecycle, while the link between changes in the marine environment and Atlantic salmon growth, diet, and distribution at sea remains unknown. Studying migratory species in a marine environment presents a challenge as direct observations are difficult to make, and the setting is spatially complex. Stable isotope analysis and compound-specific isotope analysis presents a cost-effective alternative to traditional tagging studies as a consumer's isotope ratios reflect both its trophic position and the different trophic pathways through which it assimilates energy and mass. Coupling stable isotope analysis with archived Atlantic salmon scales provides an opportunity to investigate Atlantic salmon marine ecology over a large time scale. The aim of this study is to characterize how marine primary production pathways that support Atlantic salmon populations has changed through time, by detailing the long-term trends in Atlantic salmon marine resource use, trophic position, and foraging locations of fish caught returning to Bay of Fundy rivers, and salmon caught feeding in the North West Atlantic Ocean around Greenland over a 50-year time period (1968-2019).

Affiliation

University of New Brunswick

Presentation type

Poster

Assessing the impact of heatwave exposure on the swimming performance, kinematics, and metabolism of a nearshore marine fish, Cymatogaster aggregata

Leon Tran[1], Heather Bauer Reid[2], Mar Pineda[3], Vincent Mélançon[4], John Fleng Steffensen[5], Jacob L. Johansen[1], Paolo Domenici[6]

[1]Hawai'i Institute of Marine Biology, University of Hawai'i at Mānoa, Kāne'ohe, Hawai'i, United States of America, [2]Environmental and Life Sciences Graduate Program, Trent University, Peterborough, Ontario, Canada, [3]School of Biodiversity, One Health & Veterinary Medicine, University of Glasgow, Glasgow, Scotland, United Kingdom, [4]Département de sciences biologiques, Université de Montréal, Montréal, Canada, [5]Departement of biology, University of Copenhagen, Copenhagen, Danemark, [6]IAS-CNR Località Sa Mardini, Torregrande, Oristano 09170, Italy

The severity and frequency of marine heatwaves (MHWs) have increased drastically across the globe, with some of the most intense heatwaves happening within the last decade. The consequences of MHWs vary in severity and include range shifts and diet changes as well as mortality events in marine species. In fishes, elevated temperatures can lead to changes in whole-animal metabolism and performance metrics. However, the impact of temperature on a key performance metric, optimal swim speed (Uopt) is not fully understood. Here, we investigate how heatwave exposure (I.e., +2°C and +4°C) over a five-day period affects the metabolic rate and swimming performance of the shiner perch *(Cymatogaster aggregata)* using a swimming respirometer. Preliminary findings demonstrated that Uopt slightly increased following moderate MHW exposure (+2°C) and plateaued at higher MHW exposure (+4°C). However, metabolic costs and maximum swimming speed peaked following moderate MHW exposure and declined under more intense MHWs. Not only does this provide more information on the swimming energetics and performance of a common nearshore species, but it also provides insight into heat tolerance and how this species may respond to future projected marine heatwaves.

Affiliation

Université de Montréal

Presentation type

Oral

Diel Temperature Fluctuations Influence Fish Aggression and Thermal Acclimation

Erin Francispillai[1], Lauren Chapman[1]

[1]McGill University

Deforestation can increase light penetration and runoff entering adjacent freshwaters leading to increased average water temperature, stronger diel temperature fluctuations, and increased water turbidity. Changes in temperature extremes (particularly upper peaks) are important for fishes as their body temperature and rate of oxygen consumption varies with environmental temperature. Here, we compare effects of diel-fluctuating versus stable water temperature on the behaviour and upper thermal tolerance (measured as Critical Thermal Maximum, CT_{max}) of the Bluntnose Minnow, *Pimephales notatus*. Fish were acclimated to either a static 18°C, static 24°C or a diel-fluctuating treatment of 18-24°C for a total of 10 weeks. Shoal aggression across treatment was measured using 5-minute observation periods for 6 consecutive weeks during acclimation. Fish acclimated to diel-fluctuating water temperatures showed the highest level of aggression as temperatures reached the daily maximum of 24°C (from 18°C). Following acclimation, upper thermal limits of fish from each treatment were measured under two conditions: clear water (< 2 NTU) and turbid water (25 NTU). Temperature regime affected thermal tolerance limits with the highest CT_{max} at static 24°C and the lowest at static 18°C. CT_{max} was intermediate when fish were held under diel fluctuating conditions. Exposure to acute turbidity during CT_{max} trials significantly lowered upper thermal limits across all treatments. These results show plasticity in CT_{max} in Bluntnose Minnow and underscore the importance of evaluating response to both stable and fluctuating temperatures. Our results also highlight an important interaction between dual stressors (temperature and turbidity).

Affiliation

McGill University

Presentation type

Oral

Informing the Design of Fish-Friendly Shoreline Retaining Walls for Freshwater Systems

Dr. Steven Cooke[1], Dr. Chris Elvidge[1], Dr. Keith Van de Riet[2], Samuel Woods[3], Acacia Frempong-Manso[1]

[1]Carleton University, [2]The University of Kansas, [3]Queen's University

The structural complexity of aquatic habitats is often diminished by the installation of retaining walls designed to stabilize shorelines and mitigate erosion. However, alternative armoring techniques, such as wall panels that preserve or mimic natural habitat complexity, are currently being developed. These techniques require an understanding of how different structural elements are utilized by fishes of varying body sizes.

In this study, we investigated the impact of incorporating five distinct habitat features and textures onto experimental retaining wall panels on the behavior of Bluegill (Lepomis macrochirus) across a spectrum of body sizes, in comparison to a control (plain) panel. Our findings revealed a significant relationship between fish size and treatment type. Small bluegill predominantly frequented the most complex habitat treatment, while medium and large bluegill exhibited similar preferences for two treatments that offered the highest habitat complexity. The key differentiator between these treatments was the degree of habitat relief.

Moreover, treatment type exerted a significant influence on Bluegill behavior, indicating that the various forms of habitat complexity affected the proportion of time the fish spent near treatment panels compared to control panels. These insights will contribute to the refinement of retaining wall designs aimed at providing structural habitat complexity to support freshwater fishes across diverse body sizes and life history stages.

Affiliation

Carleton University

Presentation type

Oral

Identifying barriers to connectivity for Atlantic Salmon in Nova Scotia using a field validated remote sensing framework

Habitat connectivity is an important characteristic for migratory species to access the resources and environments necessary to survive and thrive. Due to their anadromous life cycle that takes them from the headwaters of their home rivers out to the open ocean and back, Atlantic salmon (*Salmo salar*) requires extensive and well connected freshwater habitat to successfully reproduce and maintain viable populations. However, the installation of road culverts can fragment aquatic habitats and impede *S. salar* from reaching their spawning grounds. In mainland Nova Scotia, The St. Mary's River watershed represents an important habitat for *S. salar*, a population that has been assessed as 'Endangered.' To predict culvert passability in the St. Mary's River, I use orthophotography and a digital elevation model created from Light Detection and Ranging (LiDAR) to estimate culvert slopes I ground truth these estimations using culvert survey data collected over the 2023 summer. I explore the impact on field-recorded culvert variables such as dimension, shape, and material to explain a culvert's ability to pass fish. By identifying key factors influencing culvert passability and a method to predict this utilizing remote sensing and existing data, I will produce a culvert risk framework to identify culverts at risk of posing barriers to connectivity. These results can be used to prioritize areas for culvert remediation or eventual road closure and remediation to support habitat connectivity for *S. salar.*

Affiliation

Dalhousie University

Presentation type

Oral

Home range size of freshwater fishes: a meta-analysis through a new lens

Johnathan Lemay[1], James Grant[1], Dylan Fraser[1]

[1]Concordia University

The home range concept is essential for understanding meta-population dynamics, community structure, and initiating conservation and restoration practices, especially for freshwater species. As freshwater ecosystems continue to be negatively impacted by anthropogenic activities, there is a pressing need to provide a global update on the home range size of freshwater fishes. Earlier studies have shown that home range increases with fish size, waterbody size, and trophic guild. However, there is a lack of a standardized methodological approach in measuring these variables and other factors that may influence home range (e.g., study duration, fish age, sampling frequency) were not fully considered in previous meta-analyses. Here, using an updated empirical dataset of over 300 studies, we revisit previous work and re-evaluate home range estimates in both lentic and lotic environments to verify whether home range: 1) has an allometric relationship with fish length and weight; 2) is positively correlated with waterbody size; 3) is influenced by study duration; 4) and additional variables (e.g., trophic guild, fish age, sampling frequency, and latitude/longitude) may be linked. Standardizing estimates of home range and evaluating the influence and relative importance of various factors will increase our ability to predict home range sizes of freshwater fishes and provide valuable information for conservation management.

Affiliation

Concordia University

Presentation type

Oral

Body length changes for Atlantic salmon over five decades exhibit weak spatial synchrony over a broad latitudinal gradient

Tara Imlay[1], Cindy Breau[1], Guillaume Dauphin[1], Gérald Chaput[1], Julien April[2], Scott Douglas[1], J. Derek Hogan[1], Sherise McWilliam[1], Daniela Notte[1], Martha Robertson[1], Andrew Taylor[1], Kari Underhill[1], Laura Weir[3]

[1]Fisheries and Oceans Canada, [2]Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs, [3]Saint Mary's University

Understanding the factors that drive spatial synchrony among populations is important for management and recovery of populations. The range-wide declines in Atlantic salmon (*Salmo salar*) populations may be the result of broad-scale changes in the marine environment. Using a dataset that spanned five decades, 172,268 individuals, and 19 rivers throughout Eastern Canada, we investigated the occurrence of spatial synchrony in body size changes of returning wild adult Atlantic salmon. Body size was then related to conditions in the marine environment (i.e., climate indices, thermal habitat availability, food availability, density-dependence, and fisheries exploitation rates) that may act on all populations during the ocean feeding phase of their life cycle. Body size increased during the 1980s and 1990s for salmon that returned to rivers after one (1SW, 8/19 rivers) or two winters at sea (2SW, 1/8 rivers); significant changes were only observed in some mid-latitude and northern rivers and no southern rivers. For 1SW salmon in nine rivers, body size was longer when fisheries exploitation rates were lower. For 2SW salmon, body size was longer when suitable thermal habitat was more abundant (3/8 rivers) and the Atlantic Multidecadal Oscillation was higher (i.e., warmer sea surface temperatures; 4/8 rivers). Overall, the weak spatial synchrony and variable effects of covariates on body size across rivers suggests that changes in Atlantic salmon body size may not be solely driven by shared conditions in the marine environment. Regardless, body size changes may have consequences for population management and recovery through the relationship between size and fecundity.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

River-specific thermal regimes contribute to variation in thermal aggregation thresholds for juvenile Atlantic salmon (Salmo salar)

Elise Collet[1], Tommi Linnansaari[1], Antoin O'Sullivan[1]

[1]University of New Brunswick

It is well understood that Atlantic salmon (*Salmo salar*) will seek thermal refuge once certain temperature thresholds are exceeded, and these thresholds differ with age - this behaviour is termed 'thermoregulation'. However, the temperature that induces behavioural thermoregulation is not homogeneous across the range of Atlantic salmon. Recent research has shown that the temperature that triggers behavioural thermoregulation in juvenile Atlantic salmon differs for salmon in two relatively warm rivers. Here we investigate whether juvenile Atlantic salmon in one warm river, and one relatively cooler river, will exhibit a difference in aggregation onset temperatures. Further, using a hysteresis model that considers the time since the previous thermally stressful event (TsE) and the frequency of thermally stressful events (FoE), we test whether aggregation onset temperatures will vary throughout the summer. To accomplish this, we placed custom-made underwater cameras in two thermal refuges in the Miramichi River, NB, and in one thermal refuge in the Restigouche River, NB, to observe the onset of aggregations of juvenile Atlantic salmon. Water and air temperatures were also measured. The duration of this study was from June 1st to August 31st in 2022 and 2023. The results from this study further our understanding of the dynamic nature of salmonid behavioural thermoregulation and have implications for the future management of Atlantic salmon in an increasingly warming climate.

Affiliation

University of New Brunswick, Canadian Rivers Institute

Presentation type

Oral

Epigenetic technique for non-lethal age estimation in Atlantic Halibut

Atlantic Halibut are an important commercial fishery in the Northwest Atlantic, and in-depth knowledge of their population is critical for their conservation and sustainable fishing. Metrics needed for assessment, like fecundity, maturity, and mortality, require reliable age data to be accurately incorporated into models. The current method of otolith aging requires lethal sampling as well as a time-intensive protocol to age individuals. To help support this aging effort, here we present the results of genomic approach to age halibut based on DNA methylation. We conducted whole-genome methylation sequencing on 66 wild caught individuals with otolith-derived age estimates. The resulting 14,588 CpG sites were tested as predictors in an elastic net model used to estimate the genetic age. We found a significant correlation between otolith age and our methylation method (R = XX, MAE = XX), implying successful prediction of age using epigenetics. We plan to expand our testing using adaptive Nanopore sampling for more efficient and cost-effective sequencing to fully develop a method that can be implemented in the current management plan for Atlantic Halibut. This technique can be used to supplement otolith aging data and for project where non-lethal sampling is used, such as tagging studies.

Affiliation

Dalhousie University

Presentation type

Oral

Environmental factors impacting Atlantic salmon (Salmo salar) migratory patterns at sea: A modelling study

Christiane Dufresne[1], Diane Lavoie[1], Jonathan Carr[2], Joël Chassé[1], Frédéric Cyr[1], Jason Daniels[2], Guoqi Han[1], Ian Jonsen[3], Tim Sheehan[4], Marc Trudel[1], Frederick Whoriskey[5], Martha Robertson[1]

[1]Fisheries and Oceans Canada, [2]Atlantic Salmon Federation, [3]School of Natural Sciences, Macquarie University , [4]NOAA Fisheries Service, [5]Dalhousie University

Atlantic salmon stocks have declined in recent decades throughout their range. These declines have been primarily attributed to reduced survival at sea; however, given our lack of knowledge during this life stage, the contributing factors remain poorly understood. The majority of salmon research at sea has focused on the near shore migration of juvenile salmon shortly after leaving freshwater. The current study focuses on the final stage of the marine migration when salmon leave distant feeding grounds off West Greenland and return to their natal rivers to spawn.

Using a North Atlantic ocean circulation model and an individual-based model, we examined the influence of annual and predicted future physical oceanographic conditions to infer salmon migration routes. The coupled model was implemented to simulate the migratory behaviour of adults based on water temperature, swimming speed and orientation. We aim at identifying the main migration routes for returning adults and define their spatial distribution.

We analyzed various model simulations and conducted a sensitivity analysis of the numerical parameters impacting the inferred routes and timing of migration. We also explored potential modifications in oceanic conditions including current intensity and direction, and water temperature as they are predicted to be affected by climate change. Finally, we examined the influence of water temperature and main oceanic features such as fronts location, mixed layer depth and currents transport, with a specific focus on the overall traveled distance and return time to coastal waters.

Affiliation

DFO/MPO

Presentation type

Oral

Monitoring toxic cyanobacteria in Atlantic Canadian lakes using qPCR and next generation sequencing

Dave Redden[1], Clarke Brown[1], Graham Gagnon[1]

[1]Dalhousie University, Centre for Water Resources Studies

Globally, harmful cyanobacteria blooms (cyanoHABs) are becoming more frequent and are of greater magnitude and duration— a trend that is expected to continue as eutrophication and a warming climate create conditions that are increasingly favorable for cyanobacteria. Many, but not all, cyanobacteria produce secondary metabolites (cyanotoxins) that pose risks to ecosystem functions and public health. Direct quantification of cyanotoxins is costly and may not be available in all jurisdictions, so most monitoring programs rely on a tiered approach that culminates in direct toxin quantification. A key component of such a strategy is verifying the presence of cyanobacteria and, ideally, confirming whether those taxa present are capable of producing toxins. This has traditionally been accomplished through microscopy; however, this is time and labor intensive and requires a trained taxonomist.

Recently, quantitative polymerase chain reaction (qPCR) has shown promise as a sensitive and specific means of monitoring the cyanobacterial genes responsible for toxin production. In this work we used qPCR to monitor six recreational lakes with histories of suspected cyanoHABs and four drinking water supply lakes, two of which experience recurring cyanoHABs. At each of the study lakes, we collected weekly samples between spring and winter of 2022 and 2023. Here we present preliminary results of this monitoring program and discuss how next generation sequencing of the DNA extracted from these lakes will be used to improve qPCR targets and better understand microbial community dynamics in lakes experiencing cyanoHABs.

Affiliation

Dalhousie University, Centre for Water Resources Studies

Presentation type

Oral

Salmonid biomass in streams around the world: A quantitative synthesis

Kyleisha Foote[1], James Grant[1], Pascale Biron[1]

[1]Concordia University

Salmonid species are one of the most studied freshwater fish, but little is known about the spatial extent and abundance of populations in many parts of the world. We created a database using published material of over 1000 rivers with estimated salmonid biomass, covering 27 countries and 11 species. To our knowledge, the database is the largest known compilation of studies on salmonid biomass, allowing detailed analyses of differences in biomass by species, region, period, and sampling techniques. Mean global biomass is 5.2 g/m^2, and while most streams are under 10 g/m^2, there is a large range (0-70.3 g/m^2). Salmonid production recorded for 194 rivers averaged 7.4 g/m^2/yr, and biomass and production were highly correlated with a mean P/B ratio of 1.08. Biomass in New Zealand and France is significantly lower and higher, respectively, than at least five other countries. Brown trout (*Salmo trutta*) have a higher proportion of biomass estimates over 10 g/m^2 than many other species. Additionally, native brown trout populations have a higher biomass than exotic brown trout, while native brook trout (*Salvelinus fontinalis*) biomass is significantly lower than their exotic counterparts. Biomass is overall higher in small streams (less than 10 m wide) and where smaller spatial extent is surveyed, perhaps because the proportion of available habitat is higher. A slight decrease in biomass over time is observed. Expanding the list of variables in the database would be useful for developing models to predict salmonid biomass, and determining potential conditions for high biomass streams.

Affiliation

Concordia University

Presentation type

Oral

Bringing back parasites : Does the swimming performance of pumpkinseed sunfish across different acclimation temperatures relate to parasite infection?

Jeremy De Bonville[1], Marie Levet[1], Sandra Ann Binning[1]

[1]University of Montreal

Ectotherms are particularly vulnerable to climate change as their body temperature is regulated by their external environment. Sudden changes in temperature caused by heat waves can cause rapid shifts in the aerobic capacity of fishes, in turn affecting their ability to maintain normal ecological activities. In addition, rising temperatures are altering host-parasite relationships such that organisms may have to live in a world with higher temperatures and more infections. How these two concomitant stressors interact to affect animal performance remains unclear. For instance, increasing temperature and parasites may have opposing effects on maximum swimming speeds, where higher temperatures may increase some measures of performance, whereas higher parasite loads could decrease performance. We acclimated wild caught, naturally infected pumpkinseed sunfish (*Lepomis gibbosus*) to 3 temperatures (20, 25 and 30°C) and measured their maximum swimming speed (U_{crit}) and metabolic performance in a Steffensen-type swimming respirometer. Fish acclimated to warmer temperatures swam longer before exhaustion but there was no strong relationship between swimming performance and parasite infection across the 3 acclimation treatments. However, when controlling for temperature, we found that fish with fewer parasite cysts on their fins and body surfaces had higher U_{crit}, whereas fish with more cysts swam for shorter periods. Our results suggest that some infections may affect host swimming performance through increased drag, and highlight the need to include parasites in experimental physiology studies on wild animals. Considering multiple biotic stressors when measuring animal performance is important as it may reveal hidden relationships that would be missed otherwise.

Affiliation

University of Montreal

Presentation type

Oral

Twenty-five years of peering into the underwater world of aquatic vertebrates using telemetry and image capture technology

Aquatic vertebrates such as fish and turtles are difficult to study because they live in water. Fortunately, various technological solutions have opened doors for peering into their underwater world. Telemetry tools have revolutionized our ability to study free-swimming animals. However, such technology remains imperfect and there is need to combine tracking data with other information on the behaviour or environmental conditions experienced by aquatic vertebrates to truly understand their ecology. Reflecting on 25 years of combining these tools (yikes - going back to my MSc), I provide an overview of where we have been and where we are going. Examples will be diverse - from assessing parental care energetics to assessing fishway passage success to identifying spawning sites to evaluating the consequences of fisheries interactions (on fish and turtles) to winter biology (of fishes and turtles). I will also reflect on our recent work with drones and forthcoming studies using animal-borne cameras.

Affiliation

Carleton University

Presentation type

Oral

Combined effects of temperature and parasite infection on the metabolism of pumpkinseed sunfish

Marie Levet[1, 2], Shaun Killen[1, 3], Stefano Betinazzi[2, 4], Sophie Breton[1, 2], Sandra Binning[1, 2]

[1]Groupe de recherche interuniversitaire en limnologie (GRIL), [2]Université de Montréal, [3]University of Glasgow, [4]University College London

Ecothermes are particularly threatened by climate change as rising water temperaturesdirectly impact their physiological processes. Additionally, warmer environments areexpected to favour parasitic organisms, thus increasing the risk of being exposed and infectedby parasites. Both elevated temperature and parasite infection can affect individual energymetabolism across levels of biological organisation. For example, parasites and temperaturecan shift enzymatic activity and affect how an individual efficiently converts the metabolicsubstrate into ATP, causing a mismatch between the ATP available and the ATP needed tosustain energy-demanding cellular processes. While temperature and parasitism can beconcomitant stressors for ectotherms, their interactive effects on an organism's metabolismremain unknown. Here, we examined the combined effects of temperature and parasitism onindividual energy metabolism at the cellular and whole-organism levels. Wild-caught, naturally parasitized sunfish (Lepomis gibbosus) were acclimated to a temperature treatment (20°C, 25°C, and 30°C) for three weeks. We measured oxygen uptake ($\dot{M}O_2$) at their acclimation temperature for 24h using intermittent flow respirometry. We then measured the enzymatic activities of key organs (brain, spleen, gills and heart) using spectrophotometry. We predict that temperature and parasite infection act synergistically, leading to more significant increases in metabolic rates as acclimation temperature and infection load increase. Our work has for objective to highlight the importance of understanding how combined stressors affect individual physiological performance. Ultimately, this work will help us better understand the future consequences of increasing temperature on host-parasite dynamics and fish energetics.

Affiliation

Université de Montréal, Groupe de recherche interuniversitaire en limnologie (GRIL)

Presentation type

Oral

Perspectives of Cree talleymen and land users on fish habitat compensation projects in Eeyou Istchee

Kathleen Church[1], Adriana R. Aguilar-Melo[1], Anna Krupa[2], Graeme Morin[2], Thomas Stevens[3], Hugo Asselin[4], Katrine Turgeon[1]

[1]University of Quebec at Outaouais, [2]Cree Nation Government, [3]Cree Trappers Association, [4]University of Quebec at Abitibi-Témiscamingue

Eeyou Istchee which is located in the James Bay region in Northern Quebec is the ancestral home of the Cree Nation. In this area, the landscape is changing rapidly due to extensive industrial development, including forestry, hydropower, mining, and infrastructure. Efforts are being made to offset the resulting damage to freshwater ecosystems and fish populations via fish habitat compensation projects. Fish habitat compensation includes habitat conservation and restoration efforts that aim to compensate for residual harm to fish habitats due to industrial development, after efforts are first made to avoid and minimize harm. In Canada, the goal of these projects is to ensure No Net Loss of fish habitat productivity. Currently, the standards for Canadian fish habitat compensation projects are determined by the Federal Government's Department of Fisheries and Oceans (DFO), and the success and relevancy of these projects is primarily assessed through Scientific Ecological Knowledge (SEK). However, the success and relevancy of fish habitat compensation projects in Eeyou Istchee according to Cree Traditional Ecological Knowledge (TEK) is currently unknown. This research project uses Q-methodology to assess the perspectives of Cree tallymen and land users regarding fish habitat compensation projects in Eeyou Istchee to evaluate the need, success, and relevancy of these projects. Knowledge of the different perspectives of Cree land users and tallymen will be used to provide recommendations for future habitat compensation projects within the region through a two-eyed seeing approach that combines SEK and TEK and will also contribute to reconciliation efforts with Indigenous peoples in Canada.

Affiliation

University of Quebec at Outaouais

Presentation type

Oral

Water Quality Criteria for Indigenous Use in the lower Athabasca Region, Alberta

Mandy Olsgard[1], Thomas Dyck[2], Megan Thompson[3], Athabasca Chipewyan First Nation, Fort McKay First Nation, Mikisew Cree First Nation

[1]Integrated Toxicology Solutions Ltd., [2]Integral Ecology Group, [3]Thompson Aquatic Consulting

The development of oil sands extraction projects in northeastern Alberta has been ongoing for over five decades, and provincial and federal governments are considering how to allow release of treated tailings water to the lower Athabasca River. In this study, comprehensive surface water and sediment quality criteria were defined to protect Indigenous water use by Athabasca Chipewyan, Fort McKay and Mikisew Cree First Nations members in the lower Athabasca Region. Two approaches were taken. First, current condition was established by collating and analyzing recent surface water and sediment quality monitoring data and identifying representative parameter values for three flow seasons. Second, risk-based criteria were defined for valued components that reflect use of surface water by Indigenous community members; consumption of traditional foods, medicines and surface water, the health of fur bearing mammals that consume aquatic biota, the health of wildlife (birds and mammals), and aquatic ecosystem health. Available surface water and sediment quality guidelines were compiled and reviewed. When unavailable or identified as not-protective, risk-based criteria were derived using methods prescribed by regulatory agencies, using community specific ingestion rates of the most highly consumed fish and medicinal plant species estimated from a traditional food survey of 230 community members. These 'Water Quality Criteria for Indigenous Use' can be used by Indigenous communities in the region, government and regulatory agencies and industry to assess change in surface water and sediment conditions, and risks to human and ecological receptors from releases of contaminants from oil sands to the lower Athabasca River region.

Affiliation

Thompson Aquatic Consulting

Presentation type

Oral

A dynamic cyanobacterial bloom in Lake Champlain: assessing the risks of cyanopeptides from both air and water

Keri Malanchuk[1], Frances Pick[2], David McMullin[1]

[1]Carleton University, [2]University of Ottawa

Lake Champlain, sometimes referred to as the sixth Great Lake, suffers from annual toxic cyanobacterial blooms responsible for drinking water contamination, beach closures, dog deaths, and negative impacts on the local economy. A major concern during blooms is the presence of cyanopeptides, a diverse group of biologically active secondary metabolites produced by cyanobacteria. Beyond the well studied class of microcystins, advancements in analytical techniques have allowed for the identification of hundreds of other cyanopeptides including cyanopeptolins, aeruginosins, microginins, anabaenopeptins, and cyanobactins. Complex mixtures of cyanopeptides can be present at high concentrations during a bloom, however, the toxicity of many cyanopeptides remains largely unknown. Recently, concerns surrounding the health impacts of cyanobacteria have also extended past the water. A few studies have suggested that cyanopeptides may become aerosolized through wave action, highlighting inhalation as a potential understudied exposure pathway. We investigated the complete cyanopeptide profile of a dynamic *Microcystis* bloom in Missisquoi Bay of Lake Champlain over four days in both air and water.

Surface water grab samples were collected alongside 24-hour continuous air filter samples. Non-targeted mass-spectrometry-based metabolomic techniques were used to identify cyanopeptides using diagnostic product ions. As well, cyanobacterial genes including several responsible for cyanopeptide production were quantified using digital droplet PCR (ddPCR). Over the four days, the bloom moved across the bay depending on wind conditions. This resulted in a dynamic pattern of cyanopeptides with complex profiles and varying health risks through the two exposure routes of air and water.

Affiliation

Carleton University

Presentation type

Oral

Monitoring pelagic and benthic species near Atlantic salmon aquaculture using complementary techniques: video, sonar, and acoustic telemetry

Greg English[1], Michael Lawrence[1], Brent Wilson[1], Matt Black[1], Chris McKindsey[1], Marc Trudel[1]

[1]Fisheries and Oceans Canada

Aquaculture within coastal bays can provide a novel habitat for several wild species, providing a potential trophic advantage and in some cases, changing the behaviour and movement patterns of fish and decapods. Analyzing these interactions through multiple techniques may provide the best chance at understanding the effects of these operations on the surrounding ecosystem and its mobile organisms. Here, we discuss the results of using video, sonar, and telemetry as complementary monitoring techniques around Atlantic salmon farms in southwest New Brunswick. Specifically, the changes in abundance, biodiversity, and movement patterns between farm and reference sites are highlighted.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

Determining early marine survival and predation by endothermic predators on acoustically-tagged Atlantic salmon (Salmo salar) post-smolts

Greg English[1], Brent Wilson[1], Michael Lawrence[1], Matt Black[1], James Hawkes[2], David Hardie[1], Jason Daniels[3], Jonathan Carr[3], Claire Rycroft[4], Glenn Crossin[4], Fred Whoriskey[5], Cornelia den Heyer[1], Xavier Bordeleau[1], Chris McKindsey[1], Marc Trudel[1]

[1]Fisheries and Oceans Canada, [2]NOAA Fisheries, [3]Atlantic Salmon Federation, [4]Dalhousie University, [5]Ocean Tracking Network

Many Atlantic salmon (*Salmo salar*) populations have experienced significant declines for decades throughout North America and Europe. Mortality due to marine mammal predation during their early marine life could be an important factor contributing to these declines and limiting their population recoveries. However, quantifying predation events and particularly the extent of marine mammal predation on Atlantic salmon remains a challenge. Here, we will discuss the contribution of mesothermic and endothermic species predation to the mortality of Atlantic salmon post-smolts during their early marine life using acoustic telemetry. Predation events were inferred from changes in temperatures and depths experienced by acoustically tagged hatchery-reared Atlantic salmon smolts. Our results suggest that the current low return of adult Atlantic salmon observed in this area in recent years was not heavily influenced by endothermic predation on post-smolts in the first weeks at sea.

Affiliation

Fisheries and Oceans Canada

Presentation type

Oral

Hydrological and Sediment Modelling in small agricultural watersheds

Simon Bée[1], André St-Hilaire[2]

[1]INRS, [2]Canadian Rivers Institute and Institut National de la Recherche Scientifique

The degradation of soils and its detrimental consequences on aquatic environments is an increasingly important research topic in agricultural regions such as Prince Edward Island (PEI, Canada). Accurate data on suspended sediments in watercourses can serve as an effective decision-making tool in agricultural land management.

The research project aims to model flow, suspended sediment concentrations (SSC), and loads using the Soil and Water Assessment Tool (SWAT) in two watersheds in PEI. The final investigations will focus on the potential variations in hydrological and sedimentary values in the future using a relatively pessimistic climate change scenario (RCP 8.5). Finally, the likely sediment trends will be analyzed, considering their potential impacts on ecosystems.

Water level and turbidity were recorded using two water level loggers and two optical backscatter sensors (OBS) deployed in the Tuplin Creek and Spring Valley watersheds from June 2021 to September 2022.

Calibration and validation of both the hydrological and sediment models were satisfactory, with Kling-Gupta Efficiency coefficients varying between 0.51 and 0.73 and Nash-Sutcliffe coefficients varying between 0.61 and 0.73 respectively, indicating successful simulation of both variables in an agricultural context in spite of relatively short calibration and validation periods. Under the selected climate change scenario (RCP 8.5), the suspended sediment data were modeled until 2100, showing a slight increase in the average suspended sediment concentration (CSS). For the Tuplin Creek watershed, extremely high sediment peaks (>1500 mg/L) could become significantly more frequent, potentially causing more frequent and severe ecosystem disturbances according to the simulations.

Affiliation

Canadian Rivers Institute &Institut National de la Recherche Scientifique

Presentation type

Oral

Spatiotemporal Use of Created Wetlands by Freshwater Fishes in Urban Areas

Tanya A. Lemieux[1], Sean J. Landsman[1], Steven J. Cooke[1]

[1]Carleton University

Due to excessive habitat degradation and destruction globally, environmental managers have been turning to habitat creation to enhance degraded ecosystems. Given the numerous benefits wetlands provide, it is common for regulators to choose wetlands for these habitat creation projects. Such created habitats are often connected to natural waterbodies, however, little to no monitoring is performed to determine whether they provide high quality habitat, and little is known about seasonal patterns of fish use in such systems. Considering these knowledge gaps, this study is evaluating the seasonal movements of Walleye (*Sander vitreus*), White Sucker (*Catostomus commersonii*), Northern Pike (*Esox lucius*), and Muskellunge (*Esox masquinongy*) and how these movements relate to various habitat variables. This research is being conducted within two urban wetlands located along the Jock River in Ottawa, ON that were developed to compensate for the destruction of fish habitat lost due to development in the area. The information gained from this seasonal (including winter) multi-year acoustic telemetry study will inform the conservation of fish habitat by improving the understanding of seasonal habitat requirements. This study can also inform decision makers considering proposals for compensation plans.

Affiliation

Carleton University

Presentation type

Oral

Exploring the interactions between inland water-based recreation and freshwater turtles.

Albana Berberi[1], Jessika Guay[1], Gregory Bulté[1], Steven J. Cooke[1], Christina Davy[1], Vivian M. Nguyen[1]

[1]Carleton University

We conducted a review on 30 articles on human-turtle interactions during water-based recreation, 29 of which reported negative effects of water-based recreation on turtle populations. Direct negative impacts included boat collisions with turtles and accidental hooking of turtles with fish hooks, while indirect negative impacts included human presence near critical turtle habitats, and wake action with subsequent shoreline erosion. Only one article reported positive interactions between humans and freshwater turtles when installing a nondisruptive turtle observation deck. Ten articles discussed conservation measures to mitigate turtle risks during water-based recreation, but none evaluated their efficacy. Conservation measures included regulating boat types, sizes, and access points, protecting critical turtle habitat, designating “no wake” boating zones, restricting fishing permits, installing turtle basking perches, promoting public awareness and outreach, and implementing community science and stewardship programs. Future research on human-freshwater turtle interactions during inland water-based recreation could explore the efficacy of conservation measures, potential interactions outside of regularly studied boating and fishing activities, and recreation-induced habitat alterations. Also, we recommend more research on the human dimension side of human-turtle interactions, including perceptions and knowledge from water users on the interactions they experience with turtles, and their awareness and actions of pro-environmental behaviours to protect turtles during water-based recreation.

Affiliation

Carleton University

Presentation type

Oral

Water-user awareness and actions on freshwater turtle conservation during recreation.

Albana Berberi[1], Steven J. Cooke[1], Gregory Bulté[1], Vivian M. Nguyen[1]

[1]Carleton University

Local communities are a pillar for upkeeping environmental conservation goals, however their awareness and actions of conservation measures are often understudied. For our research, we focus on community awareness and actions for the conservation of at-risk freshwater turtle species during water recreation. We administered an online survey targeting water-users on the Rideau Canal waterway in southeastern Ontario - a UNESCO World Heritage site popular for water recreation and home to at-risk turtle species. Our survey resulted in over 300 respondents who have participated in water recreation in the Rideau Canal. Overall, most water-users were aware that freshwater turtle populations in the Rideau Canal were decreasing. Additionally, water-users were aware of major threats to freshwater turtles brought on by water recreation activities, including motorboat strikes, accidental hooking during recreational fishing, hooking with lost recreational fishing gear, and increase in human presence near basking sites. Water-users noted their information on turtle protection strategies were sourced mainly from social media (e.g., Facebook, Instagram, Twitter), however most water-users were unaware of local turtle protection organizations and turtle rehabilitation centers. In addition to awareness, we asked water-users to rank their willingness to voluntarily adopt turtle conservation measures during water recreation. We also asked standardized questions based on the value-belief-norm theory and the theory of planned behaviour to understand underlying factors that may influence water-user likeness to adopt turtle conservation measures. Ultimately, understanding the human dimension of conservation, including awareness and likelihood of adopting actions, is necessary to continue protecting at-risk aquatic species in Canada.

Affiliation

Carleton University

Presentation type

Oral

Creating cold-water refuges in rivers to adapt to a warming world

Kathryn Smith[1], Edmund Halfyard[2], Barret Kurylyk[1]

[1]Department of Civil and Resource Engineering and Centre for Water Resources Studies, Dalhousie University, Halifax, Nova Scotia, B3J 1Z1, Canada, [2]Nova Scotia Salmon Association, Bedford, Nova Scotia, B4B 0W8, Canada

Climate change is causing widespread river warming and a loss or fragmentation of cold-water habitat for aquatic species such as brook trout and Atlantic salmon. During periods of thermal stress when summer water temperatures are high, cold-water fishes seek out thermal refuges. In the Canadian Maritimes, river warming and associated loss of cold-water habitat has contributed to the decline in Atlantic salmon, triggering their distinction as 'endangered' in the Species at Risk Act within several watersheds. As a result, proactive human alterations of rivers, such as engineered thermal habitat creation or restoration, is an emerging research topic in this region.

The objective of this study was to investigate two proof-of-concept engineered cold-water refuge designs. In summer 2022 and 2023, we created two thermal refuges by redirecting a portion of the warm river water through an underground trench system filled with gravel to provide the subsurface residence time to cool the water. In summer 2023, we created a thermal refuge using a municipal well and a pump to discharge groundwater to the river at a flowrate of 8.89 L/s and temperature of 9ºC, when the river was up to 30ºC. The spatial extent and thermal anomalies were monitored via a drone equipped with a thermal infrared camera and water temperature loggers. Time-lapse cameras were installed to monitor fish aggregations and measure the success of the active thermal refuge system. The findings from this study will benefit future projects aiming to proactively maintain thermal diversity in warming rivers.

Affiliation

Coastal Hydrology Lab, Dalhousie University

Presentation type

Oral

Incorporating vessel dynamics into traditional abundance indices

Using catch per unit effort (CPUE) to estimate stock abundance is extremely common. However, using CPUE as an index of abundance has its limitations. One of these limitations is that traditional CPUE indices do not account for vessel movement dynamics. The multiple fishing ground (MFG) index of abundance incorporates ideas from the ideal free distribution to account for vessel movement. The MFG index is calculated as the proportion of total effort on a fishing ground multiplied by the average CPUE among all fishing grounds. Stock trends using the MFG index and traditional CPUE indices of abundance were compared using Lake Winnipeg fishery data. The commercial CPUE index of abundance was calculated using the fishery's catch and delivery data. The survey CPUE index of abundance was calculated using index net data collected by Manitoba's provincial biologists. ARIMA modelling was used to assess differences between the MFG, commercial CPUE and survey CPUE indices. Each index was used in a Bayesian Schaefer model and the predictions of the models using the different indices were compared. In future work, estimations from each index will be compared to see which provides the closest estimate to "true" stock size through simulation. This project will provide a method to incorporate vessel movement dynamics into abundance indices, either for direct use or as components of integrated analyses.

Affiliation

University of Manitoba

Presentation type

Poster

Population genomics, life-history tactics and mixed stock subsistence fisheries in the northernmost American Atlantic salmon populations

Alexandre Carbonneau[1], Julien April[2], Eric Normandeau[1], Anne-Laure Ferchaud[1], Véronique Nadeau[2], Louis Bernatchez[1]

[1]Université Laval, [2]Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP)

While Atlantic salmon from the northernmost American populations are important food resource for Inuit communities of Ungava (Nunavik), and could play a key role in the sustainability of the species in a warming climate, many mysteries remain about these remote populations. The project therefore involves documenting the extent of genetic variability in Nunavik salmon rivers, both geographically and phenotypically, and quantifying the contribution of populations and tactics in Kuujjuaq's estuarine subsistence fisheries. This work is part of the pan-Canadian FISHES (Fostering Indigenous Small-scale fisheries for Health, Economy and food Security) project, and has been carried out in collaboration with the communities of Ungava and the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs.

We used genotyping-by-sequencing to genotype 14061 SNP markers in 248 individuals from 8 rivers and 280 individuals from mixed subsistence fisheries. Our results show a hierarchical structure with an effect of isolation-by-distance. While no obvious structure was detected between marine and estuarine salmon within population, we have identified genomics regions putatively associated with those migration tactics. Finally, all fish caught in the Koksoak River estuary originate from the same river, mainly from two tributaries. However, our results show that marine and estuarine salmon significantly contribute to these fisheries, and that significant variation in this contribution is present. These results provide crucial information for the conservation of salmon populations in a changing ecosystem, as well as for fisheries management to improve the food security of Inuit communities.

Affiliation

Université Laval

Presentation type

Oral

Multi-Trophic Indicators and Environmental Drivers of Lake Communities Across Canada

Dario Di Girolamo[1, 2, 3], Zofia Taranu[2, 3], Beatrix E. Beisner[1, 2]

[1]Département des sciences biologiques, Université du Québec à Montréal, [2]Groupe de recherche interuniversitaire en limnologie (GRIL), [3]Aquatic Contaminants Research Division (ACRD), Environment and Climate Change Canada, Montréal

Freshwater ecosystems are undergoing change in the face of accelerated climate change and anthropogenic stressors. Though change in these ecosystems is occurring, it remains unclear which environmental variables are the key drivers of change and how their importance varies across space. The objective of this study was to determine which abiotic and biotic variables affect freshwater lake communities, from plankton to fish, across Canadian continental watershed basins. Using the data collected by the LakePulse network and the FisHab project, we analyzed the joint responses of phytoplankton, zooplankton, and fish trophic groups and their size traits to environmental variation across 301 lakes from 4 continental watersheds, using the Joint Species Distribution Models. The proportion of variation explained by factors defining lake morphology, water quality, and a human impact index (HI) were all significantly different among watersheds. The variation explained by water quality factors differed significantly among trophic levels. Interaction was observed between trophic group and continental watershed for joint food web variation explained by lake morphology and HI Index. Generally, the Arctic watershed and fish trophic levels had the most variation explained by environment, while the Pacific and Atlantic coastal watersheds had the least; the latter regions having more biotic interactions. These findings can be used to better understand the assembly processes responsible for lake communities and are relevant for use in future forecasting models.

Affiliation

Département des sciences biologiques, Université du Québec à Montréal. Groupe de recherche interuniversitaire en limnologie (GRIL). Aquatic Contaminants Research Division (ACRD), Environment and Climate Change Canada, Montréal

Presentation type

Oral

Jeff Hutchings: admirable man and very good friend

Many people are very familiar with the numerous and impressive scientific accomplishments of Dr. Jeff Hutchings. My focus in this presentation is to highlight the personal side of Jeff - his personality and life outside of academia. Understanding his background is fundamental in appreciating how Jeff came to achieve all he did in his scientific career. Using anecdotes and stories from friends and family, I will describe a man who enjoyed a good joke and a few beers, who was guided by a strong sense of place, a love of family, unwavering loyalty and the notion of doing ‘what was right’.

Affiliation

University of New Brunswick and Canadian Rivers Institute

Presentation type

Oral

A detailed 100-year record of terrestrial species introductions and outbreaks captured in a sediment core from Newfoundland

Kathryn Hargan[1], Amber Walker[1], Courtney White[1]

[1]Memorial University of Newfoundland

Using a paleolimnological approach, we have undertaken a comprehensive examination of long-term environmental change on the Bonavista peninsula of Newfoundland through a sediment core sectioned at 0.25 cm, resulting in an average of 2-3 years per interval. Specifically, our record of environmental change aims to track terrestrial perturbations in Newfoundland over the past ~125 years including introduction of moose, spruce-budworm outbreaks, and corresponding forest vegetation dynamics. We show sediment coprophilous fungal spores track the introduction of moose in 1904, subsequent rapid population expansion, and impacts of hunting management. Wing-scale abundance counts peak at ca. 1924, 1964, and 1973, the latter two dates overlapping with the well-studied spruce budworm defoliation period from 1967-1993. Prior to the 1970s-80s defoliation event, spruce budworm defoliation is documented for the 1940s; however, our record suggests this region of Newfoundland did not experience strong defoliation during the 1940s. The increase in wing scales during the 1920s represents an unrecorded moth outbreak event, and may not be specific to spruce budworm. From pollen analysis, the dominant regional and local forest vegetation appears stable over the past 125 years despite catchment disturbances (including forestry). Overall, the successful correlation of coprophilous spore abundance and moose population is a validation of these spores as a proxy for large herbivores, which may be applicable to population reconstructions of native caribou. Correlation between peak wing-scale abundances and known outbreaks, suggest that deeper time wing-scale counts can shed light on outbreak dynamics including time between outbreaks, intensity and contributory factors (e.g., climate).

Affiliation

Memorial University of Newfoundland

Presentation type

Oral

Associations between epigenomic and genomic variation in benthic-limnetic whitefish species pairs

Clare J Venney[1], Claire Mérot[1,2], Eric Normandeau[1], Clément Rougeux[1], Martin Laporte[1,3] , Louis Bernatchez[1]

[1]Institut de Biologie Intégrative et des Systèmes (IBIS), Université Laval, Québec, Canada
[2]UMR 6553 Ecobio, OSUR, CNRS, Université de Rennes, Rennes, France
[3]Ministère des Forêts, de la Faune et des Parcs (MFFP), Québec, Québec

Speciation research has classically focused on genetic variation, though epigenetic mechanisms such as DNA methylation can also contribute to phenotypic variation and diversification. DNA methylation may contribute to evolution and speciation due to its environmental sensitivity and effects on transcription. Methylation is also mutagenic and can induce point mutations, producing unique genetic variants in populations experiencing different environments. Here we studied independently diverged sympatric benthic-limnetic whitefish species pairs from four lakes in Europe and North America (*Coregonus lavaretus* and *C. clupeaformis*, N=64) as natural replicates of speciation. We found considerable but variable genomic and epigenomic divergence between species pairs in all lakes. We found that SNPs were enriched at CpG sites, supporting the hypothesis that DNA methylation contributed to mutagenesis. All SNP types were significantly enriched, though C/T SNPs were the most common - likely due to spontaneous deamination of methylated cytosines. We also found a significant enrichment of sites showing both genetic and epigenetic divergence between benthic-limnetic species pairs (i.e., overlap between a highly divergent SNP and a differentially methylated locus at the same CpG site). These sites could represent differentially methylated sites that have slowly undergone mutagenesis over many generations, or sites under divergent selection for both genetic and epigenetic state. This study supports the role of DNA methylation in phenotypic diversification, genetic divergence, and speciation in natural systems.

Affiliation

Université Laval

Presentation type

Oral

Understanding the social networks of captive rearing and stocking programs for Atlantic salmon conservation in Nova Scotia, Canada.

Katherine Dalby[1], Hannah L. Harrison[1]

[1]Dalhousie University

In the Canadian Maritime region, limited information exists on the social and human dimensions (i.e., values, perspectives, and experiences) of captive rearing and stocking and the contested use of these tools for conservation purposes. We present a qualitative study on Atlantic salmon conservation through captive rearing and stocking programs in Nova Scotia, Canada. The study aims to explore the knowledge gaps within the human dimensions of cultivation-based Atlantic salmon conservation and understand the social structures that support it. In this study, we conducted 20 interviews across two case studies centered around salmonid hatcheries and stocking programs in Nova Scotia, Canada. Study participants included people involved in Atlantic salmon conservation, captive rearing and stocking programs (i.e., hatchery managers, volunteers, anglers, etc.), and individuals and groups critical of using hatchery and stocking programs for conservation. Through ongoing analysis, our preliminary findings indicate that Atlantic salmon conservation via captive rearing and stocking programs requires the functional support of individuals and groups achieved through complex relationships and social networks. Moreover, study participants viewed these programs as important, if not well-defined, components of Atlantic salmon conservation in climate-driven ecological uncertainty. This work is anticipated to contribute to socio-ecological considerations of Atlantic salmon management-via-cultivation in the region.

Affiliation

Marine Affairs Program, Dalhousie University

Presentation type

Oral

Groundwater warming and impacts on aquatic ecosystems

Barret Kurylyk[1], Susanne Benz[2], Danielle Hare[3], Dylan Irvine[4]

[1]Dalhousie University, [2]Karlsruhe Institute of Technology, [3]Cary Institute of Ecosystem Studies, [4]Darwin University

Groundwater temperature is modulated and offset compared to temperatures in the atmosphere or in surface water bodies. Accordingly, discrete groundwater inflows can increase the spatial variability of river temperatures, while diffusive groundwater discharge can decrease their temporal variability. Groundwater discharge influences the distribution of cold-water habitat and may help maintain cold-water biodiversity in a warming world.

Statistical or process-based river temperature models have been applied at a range of spatial scales to model impacts of climate change on the distributions of river temperatures and cold-water habitat. However, statistical models invoke stationary assumptions that can be violated under changing thermal forcing, including changing groundwater inflow rates and temperatures. Process-based river temperature models often attempt to represent thermal impacts of changing groundwater, but these tend to ignore future groundwater warming or assume it will be in sync with atmospheric warming.

We will present a new Google Earth Engine application for modeling past, present, and future groundwater temperatures around the globe. The application is based on a heat diffusion analytical solution that is forced and parameterized with global gridded datasets and assessed via comparison to measured groundwater temperatures around the globe. Results illustrate controls on future groundwater warming rates, including the driving climate scenarios, ground thermal properties, and depth. Challenges and opportunities for translating results from this application into river temperature or habitat models will be discussed, including the use of another application that analyzes measured annual river temperature signals to determine the dominance and source depth of groundwater discharge to rivers.

Affiliation

Dalhousie University

Presentation type

Oral

A commentary on the role of hatcheries and stocking programs in salmon conservation and adapting ourselves to less-than-wild futures

Hannah Harrison[1], Valerie Berseth[2]

[1]Dalhousie University, [2]Carleton University

Hatcheries and stocking programs serve a variety of objectives, including the conservation of salmon populations. Much attention has been given to the importance of genetic integrity and adaptive capacity of salmon stocks, particularly as they interact with hatchery-origin fish. Literature on hatchery and stocking programs has increasingly focused on genetic metrics of quality and success, with genetically "wild" salmon valued over hatchery-influenced salmon. However, conservation in the Anthropocene is challenging paradigms of wildness and definitions of conservation success. For salmon populations that exist on the ragged edge of climate change where threats are unlikely to be remediated to the status of ecologies past, the definition of "wild" and, by extension, role of hatcheries and stocking, becomes convoluted. If definitions of genetically 'wild' or 'natural' salmon depend on salmon archetypes situated in historic ecologies, then what do salmon climate futures look like?

Within that context, we argue a transition is needed from primarily genetic metrics of conservation stocking that attempt to (re)create "wild" salmon, to salmon conservation metrics cognizant and accepting of the hybrid ecosystems and societies of the future. Adaptive epistemologies build on studies of knowledge to challenge how scientists engage environmental change or sociotechnical transitions. We draw on this concept to critically reflect on knowledge paradigms and values that underlie salmon conservation stocking efforts and the rapidly changing ecosystems in which they are situated. We critique 'wild' discourses rooted in western thought and advance a re-imagining of salmon conservation-via-hatchery in the Anthropocene that allows for expansive human-salmon futures.

Affiliation

Marine Affairs Program, Dalhousie University

Presentation type

Oral

Resource segregation among invasive largemouth bass (Micropterus salmoides) and local sportfish species in the Wolastoq (Saint John) River, New Brunswick, Canada

Abigale Culberson[1, 2], Tommi Linnansaari[1, 2, 3], Kelly Munkittrick[1, 4], R. Allen Curry[1, 2, 3], Phillip Harrison[1, 2, 3]

[1]Canadian Rivers Institute, University of New Brunswick, Fredericton, NB, Canada, [2]Faculty of Forestry and Environmental Management, University of New Brunswick, Fredericton, NB, Canada, [3]Department of Biology, University of New Brunswick, Fredericton, NB, Canada, [4]Department of Biological Services, University of Calgary, Calgary, AB, Canada

Invasive species are organisms which have been introduced to a new environment and have the potential to cause harm to native biodiversity and endemic species in recipient ecosystems. The popularity of largemouth bass (Micropterus salmoides) among anglers in North America has resulted in frequent introductions outside their native range. However, largemouth bass can cause significant negative impacts in ecosystems to which they are not native. In 2014, largemouth bass were discovered in the Wolastoq (Saint John) River, New Brunswick. This study aims to investigate the trophic niche of invasive largemouth bass in the Wolastoq River compared to other local sportfish in the same area. Using carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope analysis, this study compares resource use among largemouth bass, smallmouth bass (*Micropterus dolomieu*), chain pickerel (*Esox niger*), and yellow perch (*Perca flavescens*). Samples were obtained by taking a fin clip from each fish's dorsal fin and comparing each species' values to stable isotope baseline samples to identify food sources. Isotope results show significant resource segregation between bass species, and significant overlap between chain pickerel and bass species which contributes to our understanding of the interspecific competition between a recently introduced predatory fish and other socially valuable sportfish in the area.

Affiliation

Canadian Rivers Institute; University of New Brunswick

Presentation type

Oral

Numerical modeling of coastal hydrodynamics and thermal patterns in a critical lagoon ecosystem

Aida Zeighami[1], Barret Kurylyk[2]

[1]PhD Student, [2]Associate Professor

Coastal water temperatures are expected to rise in the coming decades due to changes in inflowing freshwater temperatures, heat exchange with the changing atmosphere, and thermal interactions with a warmer ocean. Although a large body of research has focused on the thermal regimes of freshwater rivers and lakes or marine environments, little work has been conducted on the thermal regimes of transitional, coastal water bodies. Water temperature is a critical water quality parameter due to its influence on physical, chemical, and biological processes, yet few studies have quantitatively considered the thermal sensitivity of coastal waters to atmospheric and marine climate change (sea-level rise and ocean warming) and the implications for vulnerable coastal ecosystems.

We focus this study in the Basin Head lagoon, a Marine Protected Area in eastern PEI that supports an endemic population of giant Irish moss that is threatened by rising water temperatures, eutrophication, and invasive species. We apply a coastal hydrodynamic model (MIKE 3 FM) coupled with a temperature module to simulate hydrodynamics and water temperature patterns in space and time. Field data (tidal levels and temperature) are used to calibrate and assess the numerical model performance, while atmospheric measurements and stream and groundwater spring discharges and water temperatures are used to form the boundary conditions. Results highlight the potential impacts of climate change on lagoon water temperatures and associated ecological dynamics, with marine, atmospheric, and hydrologic (watershed) changes exerting influences that can offset or exacerbate effects from other thermal drivers.

Affiliation

Student

Presentation type

Oral

Impacts of microplastics on the growth, behaviour and cognition of juvenile convict cichlids

Microplastics, particles between 0.0001 and 5 mm in diameter, are ubiquitous in the environment and their consumption by aquatic organisms is known to lead to a variety of adverse effects. However, studies on the effects of microplastics on prey fish have not shown consistent trends, with results varying across species and plastic type used. In this research, we manipulated the levels of microplastic (MP) consumption among juvenile convict cichlids (Archocentrus nigrofasciatus) by feeding them brine shrimp (Artemia spp.) exposed to 0, 10, or 100 MP ml-1 of virgin polyethylene microspheres (10-20 μm) for a 10-day period. We then tested groups of 3 cichlids in a 2-day maze trial, in which we measured the latency to explore and time to complete a novel maze. We found no impacts of microplastic exposure on foraging rate, growth, or competitive aggression. However, our results demonstrate that microplastics consumption shaped exploratory behaviour and maze performance. Despite these effects, we found very little microplastics remaining in the fish's bodies after the experiment. A companion experiment demonstrates that most plastic particles were egested within 24 hours. Our current results show that pristine microplastics at non-lethal levels have consequences on cichlid behaviour and learning but not growth.

Affiliation

McGill University

Presentation type

Oral

A review on an integrative approach to technoscience: Pairing underwater video/camera with tracking technology in aquatic environments

Christina Semeniuk[1], Fielding Montgomery[2], Kristen Cyr[1]

[1]University of Windsor, [2]Canadian Wildlife Federation

Technoscience has advanced technological devices to characterize the physiology, movement, and behaviour of aquatic species in response to changing environments, providing insight into a species adaptive capacity. Despite such advancements, no single device can capture the full suite of data required in understanding how species cope with environmental changes. Therefore, researchers often pair different types of technological devices. Pairing monitoring (i.e., camera or video) with tracking devices (i.e., acoustic/satellite/radio telemetry etc.) can provide information across multiple scales (fine and broad) and on the observable/unobservable environment. Each device is limited under different study-design characteristics and objectives, yet there is no systematic overview detailing how this integrative approach can been used. This talk is a complementary component to the session, “Troubleshooting Technoscience: Examining Constraints and Solutions when Integrating Underwater Video Cameras with Telemetry in Aquatic Environments” by discussing how previous studies have integrated underwater cameras/video with telemetry devices. By examining studies that have previously combined these technologies, I will highlight: 1) trends in using a variety of devices across different species types (i.e., taxonomic groups and species listings) and over time; 2) devices that have been used in variety of study design characteristics and addressed a variety of ecological objectives. This information can guide researchers in choosing the most effective device combination for their study-design characteristics and objectives. This talk will act as a preamble for the session discussion and panel that will address limitations/solutions in employing such devices in the field.

Affiliation

University of Windsor

Presentation type

Oral

ECOSYSTEM AND MIXOTROPHIC RESPONSE TO PULSED ALLOCHTHONOUS INPUTS IN LAKE PLANKTON FOOD WEBS

Riley Hughes[1, 2], Éric Harvey[2, 3], Beatrix Beisner[1, 2]

[1]Département des sciences biologiques, Université du Québec à Montréal, [2]Groupe de recherche interuniversitaire en limnologie (GRIL), [3]Département des sciences de l'environnement, Université du Québec à Trois-Rivières

Allochthonous matter may be transported to aquatic ecosystems in varying amounts and frequencies following events such as flooding or changing temperatures, thereby causing changes in lake water column biogeochemistry. It is important to better gauge organism responses to these inputs to improve our mechanistic understanding of ecosystemic dynamics under perturbed environmental conditions, which will only increase with climate change disruptions. Our objective was to understand ecosystemic responses to different types and schedules of allochthonous inputs, with a focus on the autotrophic and mixotrophic (bacterivory) responses of nanophytoplankton to such events. We predicted that allochthonous inputs high in C : nutrients would favour heterotrophy and bacterivory by mixotrophs, while low ratios would favour autotrophy. We conducted a mesocosm experiment in which we added organic matter as pulses, either through insect larvae, tree leaves or a combination of both to in-lake mesocosms. We sampled a range of biotic responses to capture ecosystem metabolism, community composition, and the relative contributions of autotrophic, heterotrophic and mixotrophic activities. Our results indicate that nitrogen and phosphorus pulses (via insect amendments) favoured autotrophic nanophytoplankton, while the addition of carbon (via leaves) favoured heterotrophy. Mixotrophic nanophytoplankton were present in all treatments, indicating that this generalist energy acquisition strategy enables proliferation in a variety of environments. However, mixotrophs were more likely to demonstrate phagotrophy with leaf amendments (high C : nutrient additions), indicating that mixotrophs will consume bacteria to acquire the nutrients that are likely limiting in the environment but also because of their low surface area : volume ratios.

Affiliation

GRIL - UQAM

Presentation type

Oral

Apoqnmatulti’k: Collaborative research for aquatic stewardship

Maggie Sutherland[1], Alanna Syliboy[2], Shelley Denny[3]

[1]Ocean Tracking Network, [2]The Confederacy of Mainland Mi’kmaq, [3]Unama'ki Institute of Natural Resources

Indigenous and coastal communities have had a rich, symbiotic relationship with the aquatic environment since time immemorial. These communities rely on aquatic resources for food security, cultural identity, and socioeconomic well-being, yet their perspectives and knowledge are often not reflected in management decisions. To achieve a healthy and resilient aquatic environment—a collaborative and holistic approach is essential. This requires bringing together diverse perspectives and knowledge systems to understand challenges and co-develop solutions that foster shared stewardship and management of aquatic resources.

Apoqnmatulti’k is a partnership among Ocean Tracking Network, Unama’ki Institute of Natural Resources, Confederacy of Mainland Mi’kmaq/Mi’kmaw Conservation Group, Marine Institute of Natural and Academic Science, Acadia University, Dalhousie University, and Fisheries and Oceans Canada. Apoqnmatulti’k is built on shared participation from Mi’kmaw, local and western scientific knowledge holders to better understand valued aquatic species.

This presentation will focus on how to build strong and inclusive collaborative research partnerships based on trust and respect. Each presenter will share experiences about the challenges and successes we have faced, and how we continue to work together to strengthen our partnership and achieve research objectives. Participants will gain first-hand insight into how incorporating diverse perspectives enhances knowledge, and ensures transparency and accessibility of information. The presentation will be followed by a Q&A.

Affiliation

Ocean Tracking Network

Presentation type

Oral

Effect of Humic Acid on the Bioavailability and Toxicity of Zn2+ and Cd2+ Ions to Chironomid Midges in Aquatic Environments

Humic substances are naturally present in the aquatic body, which can bind various metal ions in their carboxylic group, altering bioavailability and toxicity to aquatic organisms. This study aimed to investigate the effect of humic acid (HAs) on the availability and toxicity of zinc (Zn) and cadmium (Cd) ions to *Rheocricotopus* spp. larvae. Larvae were exposed to Zn and Cd ions separately, combined with dissolved HAs at concentrations ranging from 0 to 50 mg/L. The free [Zn^{2+}] and [Cd^{2+}] ions were measured using the ion-selective low-molecular-weight fluorescence probes. The fluorescence intensities of free metal ions decreased as the concentration of dissolved HAs in the test solution was increased, in both the Zn and Cd treatments. The free [Zn^{2+}] and [Cd^{2+}] ions were significantly decreased after the addition of 10 mg/L of dissolved HAs. Although this reduced accumulation can mainly be explained by the decrease in free metal ion activity in the exposure water, total Zn and Cd accumulation was higher than expected on the basis of the free [Zn^{2+}] and [Cd^{2+}] ion activity. Overall, the presence of dissolved HAs in the aquatic environment can significantly reduce the bioavailability and toxicity of metal ions to chironomid midges by reducing the levels of free ions.

Affiliation

Saitama University

Presentation type

Poster

First Report of Red Swamp Crayfish in Canada found in Nova Scotia

Linda Campbell[1], Sarah Kingsbury[2], Madison Bond[1]

[1]Saint Mary's University, [2]Department of Fisheries and Oceans

Invasive crayfish are known as “ecosystem engineers”, they cause significant alterations on their invaded ecosystems.

Invasive crayfish decrease bank stability, consume aquatic vertebrate eggs and juveniles, outcompete native fish species for space and resources, reduce aquatic vegetation, alter food web dynamics, and host multiple diseases. Nova Scotia, Canada, has no native crayfish species however, a suspected population of Red Swamp Crayfish, *Procambarus clarkii,* has been detected in Three Mile Lake, Windsor Junction, Nova Scotia.

We conducted intensive trapping and lake monitoring in Three Mile Lake, Nova Scotia, from July 2023 to December 2023, with plans to return, summer of 2024. We are also currently conducting a systemic literature review of *P. clarkii* global invasions to determine the impacts we may anticipate seeing from the species in the Nova Scotia climate.

We have confirmed the first reported presence of *P. clarkii* in Canada and the second reported presence of invasive crayfish in Nova Scotia. To date, we have caught 22 crayfish, including both males and females of varying sizes, including one female barring eggs. Various traps, baits, lake locations, and seasons were tested to determine which aspects yielded the highest catch abundance.

Based on our findings we suspect that *P. clarkii* is reproducing in Three Mile Lake, Nova Scotia. *P. clarkii* poses a serious threat to native Nova Scotian species which have not co-evolved with any crayfish species, allowing for devastating alterations to the current ecosystem.

Affiliation

Saint Mary's University

Presentation type

Poster

Towards a new paradigm for bioassessment: deep learning and computer vision approaches

Andrew Medeiros[1], Djuradj Milosevic[2]

[1]School for Resource and Environmental Studies, Dalhousie University, [2]Department of Biology and Ecology, University of Nis, Serbia

Monitoring of freshwater systems using bioassessment requires a high taxonomic resolution of indicator species that have known environmental gradients to contextualize environmental stress. However, traditional morphology-based approaches are hindered by expertise, cost, capacity, and time. This is especially true for '*dark taxa'*, such as chironomids (Diptera: Chironomidae), where there is limited knowledge of taxonomy that can inhibit their widespread use as a biomonitoring indicator. Here, we show how deep-learning and computer vision can be used to augment traditional bioassessment methods by testing the efficiency of an unsupervised algorithm in the automatic classification of species of chironomids. To that end, 2036 individual chironomid specimens assigned to 11 morphotaxa were photographed from the ventral point of view and then used for the construction of a deep learning model. We then examined chironomid mouthparts (mandibles) as a proxy for identifying the relationship between the functional morphology and food acquisition behaviour. The unsupervised deep-clustering methods used are based on visual features and allowed us to interpret latent representations unique to specific chironomid taxa from raw images automatically. A model was then built that correctly classified taxa into 4 functional feeding groups with a 98.94 % accuracy. As such, we offer a new approach that can automatically identify both the species of chironomid as well as their feeding traits, which also avoids issues surrounding both taxonomic identification and previous knowledge of a specific taxa's feeding habits. The use of deep-learning approaches could substantially enhance the use of trait-based approaches and increase reliability in bioassessment.

Affiliation

School for Resource and Environmental Studies, Dalhousie University

Presentation type

Oral

Combining Sentinel-2 and MODIS to classify lake ice: application to analyze the ice-aquatic vegetation relationship

Rodrigo Felipe Bedim Godoy[1,2], Dave Mongrain[1], Andrea Bertolo[1,2], Christophe Kinnard[1,3]

[1]Centre de recherche sur les interactions bassins versants – écosystèmes aqua-tiques (RIVE), Université du Québec à Trois-Rivières, 3351 Boulevard des Forges, Trois-Rivières, Québec, Canada; [2]Groupe de recherche interuniversitaire en limnologie (GRIL), Université de Mon-tréal, 6128 Centre-ville Station Montréal, Québec, Canada; [3]Centre d'études nordiques (CEN), Université Laval, 2405 rue de la Terrasse, Québec, Québec, Canada.

Whereas lake ice is a crucial driver of the dynamics of many lakes of the Northern hemisphere, its importance for their ecology is still not fully understood. Here, we analyze the potential relationships between lake ice and submerged aquatic vegetation (SAV) meadows, one of the major biological components in shallow lakes, by using remote sensing techniques. We used optical satellites data (Sentinel-2, 2016-2023; MODIS, 2002-2023) to reconstruct lake ice phenology in a large fluvial lake (Lake Saint-Pierre, Québec), whereas we used multibeam echosounding to measure SAV height and cover during peak growth (i.e. August) with sub-metric precision. Our main goal was to investigate the applicability of combining these methods to get better predictions of the relationship between lake ice and SAV, and explore potential relationships between these variables. Our preliminary results show that it is possible to classify lake ice with high precision (accuracy>0.80) by using images from Sentinel-2 and MODIS, despite the fact that, floating ice and suspended sediments at early spring challenged the classification. In spite of its lower spatial resolution compared to Sentinel 2, MODIS presented satisfactory results for stable ice classification in the middle winter ($0.91 \leq$ Accuracy ≤ 0.96; $0.75 \leq$ Kappa ≤ 0.83), while some misclassification between ice and water were observed in the main channel due to the presence of floating ice. Here we show some preliminary results about ice phenology and SAV biovolume during the period the summer 2021.

Affiliation

Université du Québec à Trois-Rivières

Presentation type

Poster

Advancing Indigenous Knowledge and Wisdom in the Great Lakes Basin

Jérôme Marty[1]

[1]International Association for Great Lakes Research

In 2021, the International Join Commission (IJC) started a new project designed to advance knowledge on how Traditional Ecological Knowledge (TEK) can have a meaningful role in the primarily Western science approach to IJC advice, and to develop recommendations on how to develop a framework through which TEK and Western science can collaborate within the IJC's structure within the Great Lakes.

The growing interest in understanding the collaboration between TEK and Western science has led to many publications proving recommendations on the ways institutions, governments and people should engage with Indigenous knowledge respectfully. Also, as Tribes, First Nations, Métis, and other Indigenous communities and nations have become increasingly involved in inter-jurisdictional water and resource management, there are increasing public examples of ways in which TEK and Western science have collaborated to help inform management decisions within Indigenous communities, as well as within these inter-jurisdictional regimes.

With this presentation, we report on a literature survey as well as on finding from a listening session conducted in Akwesasne. This session highlighted the need to recognize, acknowledge and respect current and past context and realities to develop a trusting relationship between science organizations and community members sharing about their experiences and knowledge. In addition, the session highlighted the importance of using a terminology that is informed by the community (and possibly grounded in the language) for effective bridging of knowledge systems.

Affiliation

International Association for Great Lakes Research

Presentation type

Oral