CCFFR δ SCL

2020

Halifax

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Welcome Statement

Welcome to the 2020 joint meeting of the Canadian Conference For Fisheries Research and the Society of Canadian Limnologists. Our Halifax program includes the annual Stevenson and Rigler lectures, 98 talks and 37 posters. We would like to highlight our poster presenters this year by giving the official poster session a prime time slot, so please make sure to visit the posters and their owners on Saturday from 3:30 PM onward. A number of student volunteers have come forward to make this conference run smoothly, so please thank them for their efforts! Our generous sponsors need some love, too, so please visit them during breaks to have a chat. Halifax is a very sociable place by reputation, so we look forward to seeing everyone at the social events and society meetings. Have a great conference! Consume donairs at your own risk. . .

Your organizing committee, Trevor Avery Laura Weir

Code of Conduct Statement

In participating in CCFFR-SCL2020 you agree to adhere to the Code of Conduct Statement.

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

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

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

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

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

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

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

Conference Venue

Four Points by Sheraton

1496 Hollis Street,

Halifax, NS

Group Reservation Name: Canadian Conference for Fisheries Research

Arrival Date: 02-Jan-2020

Departure Date: 05-Jan-2020

Room rate: $115 single or double/night; $135 triple or quadruple/night

Wifi: FourPoints

Wifi Password: comfort

The Four Points is currently upgrading the link between the hotel and the conference rooms. You will see signs directing you to access the conference centre from the hotel via the second floor - follow them wherever they take you! It is not a trick. You do not have to go outside into the Halifax winter, but you may see some construction materials on your journey. There are no cranes, and you are not in danger.

Important Presenter Information

Oral Presentations

1. Oral presentations will be 15 minutes in length (12-minute talk + 3 minutes for questions).
2. The projector will be connected to a Windows-based computer, so slides should be in either Powerpoint or PDF format.
3. Use a widescreen (16:9) slide orientation (this is typically the default).
4. Avoid using proprietary fonts (i.e. stick with Times, Arial, Calibri, Verdana).
5. Bring your presentation on a USB memory key to your presentation room volunteer to be loaded at least 30 minutes prior to the start of your session. Good times to approach the room volunteer would be prior to your session or at coffee break; be aware that even volunteers like coffee...)
6. The Explorer Room will be open most of the time for those wishing to practice or preview their talks.

Poster Presentations

1. Posters should be a maximum of 44" (112 cm) wide x 36" (91 cm) high.
2. Adhesive dots or tacks or velcro will be provided to attach posters to the poster boards.
3. Affix posters by 1 PM (13:00) on Friday, January 3rd and remove them by the end of coffee break (11:00) on Sunday, January 5th.

Conference Schedule

	Conference Schedule			
	Thursday, January 2			
	Admirals	**Navigator**	**Compass AB**	**Compass C**
16:00-20:00	Registration (Conference Centre Lobby)			
16:00-18:00	Workshop: Science Communication: Beyond the Manuscript (Capitol Room) | Data Science Workshop (Academy Room)			
18:00-21:00	Welcome Social			

	Admirals	Navigator	Compass AB	Compass C
08:30-10:00	Registration (Conference Centre Lobby)			
09:00-09:15	Welcome			
09:15-10:15	J.C. Stevenson Memorial Lecture: Mark Poesch			
10:15-10:45	Nutrition Break (Foyer)			
10:45-11:00	AFS President: Scott Bonar			
11:00-12:00	F.H. Rigler Memorial Lecture: Brian Cumming			
12:00-13:30	Poster set-up/Lunch (on your own)			
		CCFFR: Genomics and eDNA applications in fisheries and conservation	**SCL: Temporal Dynamics in Aquatic Ecosystems**	**Reproduction and Life Histories**
13:30-13:45		GEN-FISH: Genomic Network for Fish Identification, Stress and Health. Daniel Heath	A paleoenvironmental study tracking eutrophication, metal pollution, and climate change in Niven Lake (NT), Yellowknife's first sewage lagoon. Emily Stewart	Widespread decreases in northwest Atlantic monkfish (Lophius americanus) size structure. Julie Charbonneau
13:45-14:00		The replicability and reliability of eDNA applications to monitor aquatic biodiversity. Jori B Harrison	Reconstructing long-term ecological change in two highly degraded Lake Ontario (Canada) coastal wetlands. Grace N Hoskin	Investigating Atlantic tomcod (Microgadus tomcod) dietary habits and coastal migration into spawning habitat within Minas Basin, Nova Scotia. Lindsay Carroll

Friday, January 3

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	Admirals	Navigator	Compass AB	Compass C
Friday, January 3
14:00-14:15		Experimental harvesting of a socio-economically important fish species to reveal utility of eDNA to monitor abundance in harvested fisheries populations. Matthew Yates	Recovery dynamics of industrially damaged lake ecosystems (Sudbury) in response to change at multiple scales. John Gunn	Accounting for evolution in fisheries management: no ordinary fish tale. Manuelle Beaudry-Sylvestre
14:15-14:30		Evolutionary and demographic history of introduced brook trout in national park alpine lakes. Brent Brookes	Seasonal dynamics of fish community isotopic niches in natural and constructed fish habitats. Karling Roberts	Does the complexity and variability of early rearing environment influence responses to novel environmental situations in brook charr (Salvelinus fontinalis)? Melissa Goodwin
14:30-14:45		Exploring fish microbial communities; opening the fish microbial black box. Javad Sadeghi	Seasonal variation in CO2, CH4, and N2O emissions from small farm reservoirs in the northern Great Plains. Sydney Emmons	Combined effects of maternal traits and spring warming patterns on spawning success of walleye. Sara Lehman
14:45-15:00			Assessing the impacts of Dorset Palaeoeskimo on freshwater ecosystems at Port au Choix, Newfoundland using paleolimnology. Kristen Coleman	Aspects of Thermal Acclimation in Juvenile Brook Trout (Salvelinus Fontinalis). Theresa Mackey
15:00-15:30	Nutrition Break			
		CCFFR: Genomics and eDNA applications in fisheries and conservation	**SCL: Temporal Dynamics in Aquatic Ecosystems**	**Telemetry/Tagging/Passage**

	Admirals	Navigator	Compass AB	Compass C
Friday, January 3				
15:30-15:45		Assessing genomic vulnerability to climate change in Canada's northernmost freshwater fish, Arctic charr. Kara Layton	Paleolimnological assessment of eutrophication of southwest Nova Scotian lakes in relation to the local fur farming industry. Nell Libera	Sofishticated tracking: improved protocol for acoustic tagging of sensitive Clupeid fishes, and application in investigating postspawning migration of Alewife (Alosa pseudoharengus) in Minas Basin, Bay of Fundy. Elizabetha Tsitrin
15:45-16:00		Genetic differentiation among sympatric resident and anadromous Arctic char (Salvelinus alpinus) in Labrador, Canada is largely non-parallel but for a few key genes. Sarah Salisbury	Using Midge Remains to Assess the Impacts of Mink Farming on Hypolimnetic Oxygen in Lakes from Southwestern Nova Scotia. Julia Campbell	A practical method to account for variation in detection range in acoustic telemetry arrays to accurately quantify the spatial ecology of aquatic animals. Jacob W Brownscombe
16:00-16:15		Chromosomal inversions in the Atlantic cod genome: implications for management of Canada's Northern cod stock.. Scott Pavey	Tracking past inputs from mink farms using lake sediment cores in southwestern Nova Scotia. Jules Blais	Current and emerging statistical techniques for aquatic telemetry data: A guide to analysing spatially discrete animal detections. Kim Whoriskey
16:15-16:30		Structural variation and polygenic divergence drive population structure in Atlantic halibut. Tony Kess		The American Fisheries Society Standard Methods for Sampling North American Freshwater Fishes Project Update. Scott A Bonar

	Admirals	Navigator	Compass AB	Compass C
		Friday, January 3		
16:30-16:45		Patterns of gene flow, morphological variation, and environmental associations in southern Newfoundland Atlantic Salmon (Salmo salar). Ben Perriman		Climbing the wall: Evaluation of American Eel Interactions with Low-Overhead Dams. Brandon Nilsen
16:45-17:00		Environmentally associated chromosomal structural variation influences fine-scale population structure of Atlantic salmon (Salmo salar). Beth Watson		Use of new (High Residency) and traditional (coded) acoustic tagging technology to predict if Atlantic Sturgeon (Acipenser oxyrinchus Mitchill, 1815) will spatially and temporally overlap with a tidal turbine test site in Minas Passage, Nova Scotia.. Jessie Lilly
17:00-19:00		CCFFR Meeting		
20:00-23:00	Student Social (Pacifico)			

	Saturday, January 4			
	Admirals	**Navigator**	**Compass AB**	**Compass C**
		CCFFR: Genomics and eDNA applications in fisheries and conservation	**CCFFR: Shifting resource dynamics in rapidly-changing marine ecosystems**	**Gone Fishn'**
09:00-10:15		Intergenerational transfer of maternal effects via DNA methylation in Chinook salmon. Clare Venney	Seasonal migrations and habitat use in the recovered stock of Atlantic halibut in the Gulf of St. Lawrence. Dominique Robert	Climate and the Black Swan in Arctic fish populations. Ross Tallman
09:15-09:30		Range-wide genetic assignment reveals long-distance migration in Atlantic salmon. Ian Bradbury	Arctic Salmon: Community-led initiatives monitor increasing salmon in the Canadian Arctic. Karen Dunmall	Physiological and behavioural consequences of ice angling in freshwater fishes. Caleb Hasler
09:30-09:45		Moving beyond single-SNP approaches for understanding the genetic basis of Atlantic salmon age-at-maturity. Marion Sinclair-Waters	Connectivity and migratory movements of Greenland Halibut from Greenland coast in Northwestern Atlantic. Laélien Bassi	Seasonal patterns in scallop fishery discards of Atlantic cod, haddock, and yellowtail flounder inform risk-based management decisions. Freya Keyser
09:45-10:00		Beyond hybridization: five years of genetic monitoring following a large escape of farmed salmon in southern Newfoundland indicates continued introgression. Melissa Holborn	The return of the Striped Bass in the St. Lawrence River: Habitat utilization and distribution range. Pascal Sirois	Physiological and behavioural effects of catch-and-release angling on freshwater drum across seasons. Jamie Card

	Admirals	Navigator	Compass AB	Compass C
10:00-10:15			Light-hearted lobsters: using a novel methodology with free-ranging heart rate biologgers to assess the effect of light pollution on stress in Spiny Lobster (Panulirus argus). S Clay Steell	Gamefish movement drives homogenization of Ontario freshwater fish communities. Matthew Guzzo
10:15-10:45	Nutrition Break			
		SCL: Aquatic Invasive Species in Canada	**CCFFR: Shifting resource dynamics in rapidly-changing marine ecosystems**	**Salmonid Ecology**
10:45-11:00		Effects of wave exposure on the population dynamics of the invasive bryozoan Membranipora membranacea in the Eastern Shore Islands, Nova Scotia. Claire Attridge	Do regime shifts beget regime shifts? Cod, fishing, and the environment.. Jeffrey Hutchings	Improvement of Atlantic salmon post-stocking recruitment success and survival by induced neophobia training. Istvan Imre
11:00-11:15		Quantifying the relative effects of environmental conditions and kelp bed characteristics on the population dynamics of an invasive epiphytic bryozoan on a regional scale. Conrad Pratt	Rehatching the redfish-Calanus ecological interaction in the Gulf of St. Lawrence: the reliance of larval redfish on Calanus eggs. Corinne Burns	A quantitative review of density-dependence in salmonids: biological mechanisms, methodological biases, and management implications. Jean-Michel Matte

	Admirals	Navigator	Compass AB	Compass C
			Saturday, January 4		
11:15-11:30		Non-native chain pickerel and smallmouth bass integration and impacts in Maritimes freshwater food webs. Linda Campbell	Community size spectra provide indicators within recovering fisheries ecosystems on the Newfoundland and Labrador shelf. Kyle Krumsick	Extreme life-history variation in non-anadromous Atlantic salmon: adaptation or constraint? Jeffrey Hutchings
11:30-11:45		Ecological thresholds of the Chinese mystery snail (Cipangopaludina chinensis). Meghan Fraser		Does personality in hatchery Atlantic salmon predict metabolic rate and life history? Kathleen Church
11:45-13:30	Lunch (on your own)	SCL Meeting		
		CCFFR: Science for spatial planning in changing aquatic environments	**SCL: Applying limnology to solve problems in the 21st century**	**Models and Such**
13:30-13:45		Habitat quality modeling : A comparison of models based on fish densities from Snorkeling and Video Recording visual sampling. Cynthia Guéveneux-Julien	The role of submergent and emergent vegetation in mitigating water quality in urban stormwater management ponds. Alexandra Johnston	Assessing the impacts of threats to the survival of the Plains Sucker (Pantosteus jordani) in the Milk River. Taylor MacLeod
13:45-14:00		Implications of spatiotemporal variation in the distribution of Atlantic cod and Yellowtail flounder for management of time-area closures on Georges Bank. David Keith	Aquatic Ecosystem Senescence of Wetland Impoundments in the Upper Bay of Fundy. Jacob Demers	Restoration of Atlantic salmon in a crowded world: effects of interspecific and intercohort competition. Jim Grant

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	Admirals	Navigator	Compass AB	Compass C
Saturday, January 4				
14:00-14:15		Estimating benthic population abundances using trap fisheries data. Eric Pedersen	Landscape controls of water quality indicators to inform management of agricultural reservoirs. Kerri Finlay	Sand lance (Ammodytes spp) biomass and distribution on the Newfoundland Shelf. Scott Morrison
14:15-14:30		Simple metrics of ecological connectivity for application to the design of marine protected areas. Arieanna Balbar	Urban wastewater induce shift from suspended to benthic primary production in small eutrophic stream of the Northern Great Plains. Nathanael Bergbusch	Does use of habitat selection phenotypes increase the predictive power of fish habitat models? Emmanuelle Chrétien
14:30-14:45		A human impact metric to inform the spatial management of coastal ecosystems. Grace Murphy	Plankton communities in Lake Ontario coastal wetlands are structured by water quality conditions along an urban-agricultural land-use gradient. Eric Anderson	Long-term monitoring protocol for American Eel (Anguilla rostrata) based on high performance computing simulations of sampling effort. Judith Bjorndahl
14:45-15:00		Prioritizing spatial fisheries management using machine learning on diverse information sources to identify habitat function and conservation threats. Jacob W Brownscombe	Exploring salinization trends and drivers in prairie aquatic ecosystems. Matthew Bogard	Updated Bayesian surplus production modelling of an experimental giant red sea cucumber (Parastichopus californicus) fishery in British Columbia for the Kitasoo/Xai'xais Indigenous Group. Reid Steele
15:00-15:30	Nutrition Break			
15:00-16:00		CARS-AFS Meeting		

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	Saturday, January 4			
	Admirals	**Navigator**	**Compass AB**	**Compass C**
15:30-17:00	Poster Session			
18:00-21:00	Banquet			

	Admirals	Navigator	Compass AB	Compass C
		CCFFR: Science for spatial planning in changing aquatic environments	**SCL: Applying limnology to solve problems in the 21st century**	**Novel Tools**
09:00-09:15		Modelling Northwest Atlantic demersal fish and benthic invertebrate assemblages in support of marine protected area network planning. Ryan Stanley	Fire, ice, and peat: Assessing the impact of forest fire to lakes of the subarctic peatlands. Tom Pretty	Measuring scientific impact beyond citation count, a fisheries case study. Aliana Hellmuth
09:15-09:30		Borrowing from paleontology, art and engineering: presenting a novel method to create artificial habitats using 3D printing and casting techniques. Aneri Garg		Distinguishing natal habitat of Newfoundland Capelin (Mallotus villosus) using otolith microchemistry. Ashley Tripp
09:30-09:45		Seasonal mixing across jurisdictional lines between two populations of a freshwater piscivore. Graham Raby	Will zooplankton on the great plains be able to "keep up" with climate-driven salinity change? Mariam Elmarsafy	Drop-Camera Surveying: An Alternative Method of Data Collection for Improved Resource Management Within Sea Cucumber Fishing Areas. Danni Harper
09:45-10:00		Investigating migration patterns of Atlantic herring in light of environmental change: A case study for industry led science contributing to improved understanding of stock structure. Jenna Munden	Nutrient composition of Mayfly excretion across streams that vary in dissolved organic carbon (DOC). Marina Taskovic	Impact of seiches on assessment of fish species abundance in Lake Erie coastal wetlands.. Nathan Tuck

Sunday, January 5

	Admirals	Navigator	Compass AB	Compass C
10:00-10:15		Habitat mapping in support of sustainable management of benthic resources. Jessica A Sameoto	Nutritional co-limitation of Daphnia by phosphorus and calcium revealed through experimental nutrigenomics. Paul C Frost	A Canadian Case Study Of Using Mobile Technology To Provide A Scalable Alternative To Traditional Creel Surveys and Netting Surveys. Sean Simmons
10:15-10:30		Identifying habitat associations for fishes in Lake Winnipeg using large scale bathymetric and substrate data linked with fish telemetry data. Tyana Rudolfsen	What influences the interannual variability of lake water chemistry in Arctic river delta lakes? Ryan Scott	Managing uncertainty and reproducibility in cryptic skate classification. Danielle Quinn
10:30-11:00	Nutrition Break			
		CCFFR: Science for spatial planning in changing aquatic environments		**Pollution/Contaminants**
11:00-11:15		Identifying corridors of connectivity using genomic estimates of migration and resistance pathways to inform Marine Protected Area network design in the Northwest Atlantic. Nick Jeffery		Reducing mercury concentration in Northern Pike in a small Subarctic lake using intensive fishing. Heather Dixon
11:15-11:30		Beyond the next horizon: an open dialogue on the future of marine spatial planning in Canada's oceans. Noreen Kelly		The Impact of Boat Noise on Freshwater Fishes. Katherine Fedoroff

Sunday, January 5

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	Admirals	Navigator	Compass AB	Compass C
		Sunday, January 5		
11:45-12:00				Emergent insects as contaminant biovectors at historical gold mine sites. Molly LeBlanc

J.C. Stevenson Award

Mark Poesch is this year's recipient of the J.C. Stevenson Award sponsored by Canadian Science Publishing. Mark is an Associate Professor at the University of Alberta in the Department of Renewable Resources. He sits on both the federal and provincial listing bodies for species at risk in Canada, and numerous other inter-governmental committees and non-governmental groups, including as the outgoing president of the Canadian Aquatic Resources Section of the American Fisheries Society, the largest professional group focusing on fishes in Canada. Mark has been worked extensively on issues related to the decline in freshwater biodiversity, including on effects of habitat loss and fragmentation, metal contamination and invasive species.

He will present the J.C. Stevenson Memorial Award Lecture: "Assessing Habitat Connectivity for Freshwater Fishes: Challenges and Opportunities"

Abstract: Habitat connectivity is a vital for the conservation of biodiversity. In the past decade, there has been a large increase in publications related to habitat connectivity throughout the ecological literature. During the same time, publications related to habitat connectivity in freshwaters have not increased. This talk will highlight some of the unique challenges in adopting concepts of habitat connectivity into freshwaters, including: 1) the immensity of measuring habitat connectivity, 2) how to incorporate life history and other metrics into measures of habitat connectivity, 3) how to incorporate dynamic features of rivers, and 4) how to measure habitat connectivity into the future. Despite these challenges, in the past decade there have been several advancements that provide opportunities to address these challenges in freshwaters. Advancements in biotelemetry coupled with new modelling approaches have greatly aided in delineating species-habitat relationships as well as connectivity of those habitats. This talk will highlight both the challenges and opportunities in measuring habitat connectivity in freshwaters with an emphasis on enhancing management of declining freshwater fishes.

F.H Rigler Award

Brian Cumming is this year's recipient of the Frank Rigler Award, the highest honour given by the Society of Canadian Limnologists. Brian is a professor in the Department of Biology at Queen's University (Ontario, Canada) where he is a co-director of the Paleoecological Environmental Assessment and Research Laboratory (PEARL), and the Head of the Department of Biology. Brian received his BScH and PhD from Queen's in 1987 and 1991, respectively. He was a visiting scientist at the University of Bergen (Norway) and an NSERC Post-Doctoral Fellow at the Limnological Research Center (Dept. of Geology) at the University of Minnesota, prior to starting his tenure as a faculty member at Queen's in 1994. He has authored well over 130 peer-reviewed scientific papers, notes and book chapters on a wide variety of topics with a focus on the development and application of limnological and paleoecological approaches to assess environmental change.

He will present the Frank Rigler Memorial Award Lecture entitled: "The importance of Scale in Understanding Lake Response to Anthropogenic and Natural Forcings"

Talk abstract: A long-term perspective is essential to understand how aquatic ecosytems change over time from either anthropogenic or natural forcings. However, very few lakes have monitoring records that predate the onset of major anthropogenic forcings, and even fewer have monitoring records that extend over periods of large changes in climate. In this presentation, I will outline how sediment records, spanning decades to centuries, have contributed our understanding of the how algal and invertebrate communities have responded to anthropogenic forcings, such as eutrophication and acidification. Similarly, I will address the importance of scale in understanding lake response over periods of past changes in climate over millennia, and how these records provide insights into issues related to both water quantity and quality.

Workshops

Student and ERC Workshop

Science Communication: Beyond the Manuscript

Date: Thursday, January 2nd

Time: 4-6 pm

Room: Capitol Room

Facilitators: Dr. Josh Thienpont & Dr. Jérôme Marty

Registration:
https://www.eventbrite.ca/e/science-communication-beyond-the-manuscript-tickets-81308857983

More detailed information can be found in the posters below (French and English version available), if you have any questions you can contact Kristen Coleman kcoleman@yorku.ca

Data Science Workshop

Data Wrangling with {tidyverse} Pipelines

Date: Thursday, January 2nd

Time: 4-6 pm

Room: Academy Room

Facilitator: Danielle Quinn, Instructor Trainer/Instructor for The Carpentries and RStudio, and helpers!

Registration: danielle.quinn@mun.ca

The tidyverse is a collection of R packages designed for data science. All packages share an underlying design philosophy, grammar, and data structures, making it easier for users to write readable, flexible code to tackle a wide range of data challenges. In many disciplines, including fisheries and wildlife sciences, these tools are becoming increasingly popular and represent a valuable research skill set!

Prerequisites: Basic R Knowledge

Q. I don't know if I meet the suggested prerequisite!

- Do you know how to look at the first few rows of a data frame in R?
- Do you know the difference between numeric data and character data in R?
- Do you know how to apply a function in R?
- Do you know how to print a specific column from a data set in R?

A. If you've answered "yes" to at least two of the above questions, you are ready for this workshop! If you're uncertain, please reach out - I'm happy to discuss your concerns and help you determine if this workshop is right for you!

Workshop Objectives:

1. Subset and summarise data frames in a readable, reproducible way using {dplyr} functions.
2. Clean and merge data using {tidyr} and {dplyr} functions.
3. Create workflows (pipelines) to accomplish tasks including subsetting, manipulating, and summarising data to generate figures and tables.

4. Use code-folding techniques to organize and navigate your R scripts.

Preworkshop Instructions:

1. Install R and RStudio
2. Install the {tidyverse} packages

Please come prepared! If you have any problems, I will be holding "office hours" before the workshop to help you set up the software.

Symposia

Canadian Conference For Fisheries Research

Genomics and eDNA applications in fisheries and conservation

Co-Chairs: Ian Bradbury, Paul Bentzen and Daniel Heath

Over the last decade, disruptive advances in DNA sequencing have drastically altered the amount of DNA that can be sequenced cheaply and quickly. Massively parallel DNA sequencing platforms have reduced the cost of DNA sequencing by orders of magnitude and democratized the field by putting unprecedented sequencing capacity in the hands of individual researchers. The ability to sequence unprecedented amounts of DNA means a functional understanding of differences among individuals, populations, and species is now possible as well as the reconstruction of community composition from environmental DNA. This has prompted a paradigm shift in how natural systems are studied and opened up countless new applications and questions that can be addressed quickly and cheaply. As a direct consequence, genomic tools now offer broad reaching potential to contribute to and in some cases transform how most aspects of aquatic conservation and management are conducted. This session will explore these potential applications including how advances in sequencing capacity are being used to identify stocks or populations, manage mixed stock fisheries, manage invasive species, threatened or endangered species, predict effects of and plan for climate change impacts, design marine protected area networks, and manage aquaculture impacts.

Science for spatial planning in changing aquatic environments

Co-Chairs: Noreen Kelly[1] and Ryan Stanley[1]

[1] Fisheries and Oceans Canada, Coastal Ecosystem Science Division, Bedford Institute of Oceanography

Noreen.Kelly@dfo-mpo.gc.ca, Ryan.Stanley@dfo-mpo.gc.ca

Spatial planning is emerging as a valuable management approach that can balance competing human uses of aquatic ecosystems, while considering the need for the conservation of species and habitats. Added to this picture are the sustainability challenges of biodiversity loss and climate change, and the general lack of comprehensive baseline information on which to monitor and manage change in a dynamic aquatic environment. Thus, the success of spatial planning as a tool to address such complexities requires scientific studies that integrate information across a variety of disciplines (i.e., physical, biological, socio-economic) and spatial-temporal scales. This session will showcase research that can be used to inform the spatial management of aquatic ecosystems. We welcome presentations that: (1) develop scientific questions, approaches, models, and/or spatial tools that can inform the management of seascapes or protected areas; (2) apply monitoring and/or survey approaches to measure; (3) highlight technological approaches (e.g., seafloor mapping) to develop ecological baselines, as precursors to evaluating change; and/or (4) estimate the spatial distribution of existing and/or emerging pressures (e.g., fishing pressure, habitat loss) and/or the associated biological response (species or habitat) in an iterative or cumulative fashion. Overall, this session will provide a forum for discussion and information sharing on how to accomplish comprehensive spatial planning to address the multitude of pressures facing changing aquatic ecosystems.

Shifting resource dynamics in rapidly-changing marine ecosystems

Co-Chairs: Dominique Robert[1] and Jonathan Fisher[2]

[1] UQAR, CRC in Fisheries Ecology

[2] Fisheries and Marine Institute, MUN

Over the past two decades, numerous regions of Canada's three oceans have undergone an accelerating warming trend. In addition to the direct physiological effects of warming conditions on marine organisms,

increasing temperatures have in some cases altered the composition and phenology of secondary producers and predators, leading to potential trophic mismatches and recruitment failure for dominant fisheries resources, and to the emergence/recovery of new or previously-collapsed stocks. These rapid changes in fisheries ecosystem dynamics and aquaculture production potentially pose major risks and opportunities for Canadian coastal communities and industries. In these contexts, it is essential to identify mechanisms through which environmental variability drives marine productivity dynamics, as prescribed by the revamped Fisheries Act and the current DFO-led initiative to implement an ecosystem approach to fisheries management in Canada. In this session, we welcome a wide range of contributions focusing on the processes through which changing marine environments and habitats affects commercial/recreational/subsistence fisheries dynamics and aquaculture production. We also welcome case studies focusing on challenges and opportunities related to the exploitation of recovering and emerging resources.

The Society of Canadian Limnologists

Applying limnology to solve problems in the 21st century

Co-Chairs: Kerri Finlay, Roxane Maranger and Matthew Bogard

Canada has a long and diverse history of applied limnological research. This session aims to build on this history by fostering a broad and interdisciplinary discussion around environmental problem solving in the 21st century, with the key criteria being the application of limnological concepts, knowledge, and techniques. Presentations on all issues are welcome, from local- to global scales, from organismal to landscape-scale biogeochemical, and everything in between.

Aquatic invasive species in Canada

Co-Chairs: Linda Campbell[1] and Sarah Kingsbury[2]

[1] Director of Saint Mary's University School of the Environment and Senior Research Fellow of the Dynamic Environments and Ecosystem Health Research Group

[2] MSc Candidate at Saint Mary's University studying Chinese mystery snails, *Cipangopaludina chinensis*, a potentially invasive freshwater species

Aquatic invasive species (AIS) are non-native fish, invertebrate, or plant species that negatively impact negative species (Fisheries and Oceans Canada, 2019). AIS cause a decline in biodiversity and have negative economic implications for populations taxed with the proper management of these species (Officer of the Auditor General of Canada, 2019). AIS is becoming an increasing 'hot-topic' in Canada as Canada is a vast country with little aquatic oversight and very limited ability to control the influx and establishment of invasive species (Office of the Auditor General of Canada, 2019). Many Canadian provinces are trying to establish AIS monitoring programs to help control/prevent the further spread of AIS within a province, but little has been done to connect these organisation in a way to promote knowledge sharing (Alberta Parks, 2019, Environmental Reporting BC, 2015, Government of Saskatchewan, 2019, Office of the Auditor General of Canada, 2019). Management of AIS is tricky because invaded ecosystems are dynamic and cross-boundary (e.g. water that connects multiple countries). As there are four pillars to AIS management (prevention, early detection, response, control and management), each provincial and the federal government focuses resources on different pillars and often offer citizens different management tools (e.g. informative websites, AIS reporting phone apps, clean-drain-dry boater programs) which means that various approaches to AIS management have been or are being tested, but the results of those programs are not always made easily accessible (Crall et al., 2010, Fisheries and Oceans Canada, 2019). Therefore, moving forward in Canadian water management, AIS management program results need to be shared at conferences such as the Canadian Society of Limnology.

The proposed AIS session will cover topics such as an overview of AIS in Canada, AIS impacts on invaded ecosystems, indigenous people impacted by AIS, AIS management at the provincial and federal levels, AIS

research being conducted in Canada, and lessons-learned (what has worked for some provinces or other countries). We will be inviting speakers for each category, as well as student presenters, to ensure that this session offers a well-rounded view of the current AIS situation in Canada, so that participants can look to the future with full understanding of the present.

Temporal dynamics in aquatic ecosystems

Co-Chairs: Kristen Coleman[1], Jennifer Korosi[1] and Joshua Thienpont[1]

[1] York University

In aquatic ecosystems, driver-response relationships are often not readily apparent from shortterm observations, due to phenomena like legacy effects, time lags, and ecological memory. Consequently, a long-term perspective on aquatic ecosystem change over decadal, centennial, and millennial timescales can reveal new insights into ecosystem processes and trajectories of change. For this session, we welcome contributions that explore temporal dynamics in aquatic ecosystems, either through instrumental or monitoring records, or reconstructed from paleoenvironmental archives. Examples of potential themes include the influence of past events on current ecosystem processes, drivers of ecological change acting on long timescales (e.g. climate oscillations), ecosystem regime shifts, and discussions of the challenges of collecting long-term data on aquatic ecosystem processes.

Poster presentations

The list of posters being presented in the Admirals North room begins on the following page.

	Poster Numbers	
Poster	**Authors**	**Title**
1	Bailey H Silver, Rod G Bradford, and Michael JW Stokesbury	Quantifying pigmentation and biological characteristics of Anguilla rostrata using image analysis software over migration period.
2	James Kho, M Lisette Delgado, Gregory McCracken, Jenna Munden, and Daniel E Ruzzante	Clupea harengus: Reciprocal transplant of spring and fall spawning herring.
3	Sebastian Theis, Mark Poesch, Dak de Kerckhove, and Cameron Stevens	Comparing fish populations in shallow northern boreal lakes using mobile hydro-acoustic surveys: Benefits and biases.
4	Victoria Van Mierlo and Mark Poesch	Assessing community concordance metrics for assessing anthropogenic land use effects on aquatic ecosystem integrity in the North Saskatchewan River.
5	Jonathan Fisher, Wade Hiscock, Chris Dawe, and Susan Fudge	Marine ecosystem surveys in the Pangnirtung region explore community-based fisheries options and characterize species-habitat distributions.
6	Lola Coussau, Dominique Robert, and Pascal Sirois	Studying redfish stock dynamics in the Gulf of St-Lawrence using otolith microchemistry.
7	Marie-Pier Boulanger, Hugues Benoît, Arnault Le Bris, and Dominique Robert	Inferences on environmental associations and depth-specific behaviour of Atlantic halibut (Hippoglossus hippoglossus) in the Gulf of St. Lawrence using pop-up satellite archival tags.
8	Safouane Khamassi, Marie-Julie Roux, and Dominique Robert	Baited Remote Underwater Video (BRUV) to assess fish and invertebrate community structure in the Estuary and Gulf of St. Lawrence.
9	Sarah Brown-Vuillemin, Réjean Tremblay, Pascal Sirois, Denis Chabot, Louis Bernatchez, and Dominique Robert	Trophic ecology of redfish (Sebastes sp.) to optimize resource management in the Gulf of St. Lawrence.
10	Ashley Watt, Ryland Corchis-Scott, Colin McFarlane, Trevor E Pitcher, and Chris C Wilson	Winter eDNA assessment of endangered Redside Dace (Clinostomus elongatus) in the Greater Toronto Area.
11	Karl Weise	Detecting Brook Trout (Salvelinus fontinalis) Seasonal Habitat Use in Haliburton County, ON Using Environmental DNA.
12	Samuel Prystupa, Gregory McCracken, Robert Perry, and Daniel E Ruzzante	Population Genetics Analyses of Yukon Arctic Grayling.
13	SJ Lehnert, T Kess, KKS Layton, P Bentzen, I Paterson, N Barson, MP Kent, S Lien, JB Dempson, and IR Bradbury	Divergent supergene explains age of seaward migration in multiple lineages of Atlantic salmon.
14	Sarah Kingsbury, Andrew Sinclair, Jason LeBlance, Trevor Avery, and Linda Campbell	Case study of Chinese mystery snail, Cipangopaludina chinensis, reveals new insights into gaps in freshwater quality monitoring programs in Nova Scotia.

	Poster Numbers	
Poster	**Authors**	**Title**
15	Evelien VanderKloet, Nikki Beauchamp, Megan Bailey, Joseph Beland, Rod Bradford, Lindsay Carroll, Shelley Denny, Gabrielle Deveau, Sara Iverson, Shannon Landovskis, Darren Porter, Michael Stokesbury, and Fred Whoriskey	Apognmatulti'k: Integrating Mi'kmaw, local, and Western knowledge to enhance aquatic stewardship in Nova Scotia, Canada.
16	Kayla Hamelin, Megan Bailey, and Jeff Hutchings	Novel approaches to strengthening assessments of data-poor fisheries and conservation-dependent species.
17	Gretchen L Lescord, Thomas A Johnston, Matthew Heerschap, Constance M O'Connor, F Meg Southee, Brian A Branfireun, and John M Gunn	Arsenic, chromium, and other elements of concern in fish from remote boreal lakes and rivers: drivers of variation and implications for subsistence consumption.
18	Jillian A Leonard and Edmund A Halfyard	Acid rain and salmon recovery: success and expansion of the West River Acid Rain Mitigation Project.
19	Omar S Taboun, Edmund A Halfyard, and Christina AD Semeniuk	Effects of acidification treatment on personality-dependent spatial ecology of migrating Atlantic salmon smolts.
20	Alex Di Lonardo and Joshua Kurek	Lake sediments help recognize the historical presence of a nuisance alga on Vancouver Island, British Columbia.
21	Anna Kramer, Joelle Young, and Marguerite A Xenopoulos	Using early warning indicators to predict critical transitions in a natural aquatic ecosystem.
22	Emily J Barrie, Gregory S Piorkowski, Suzanne E Tank, and Rolf D Vinebrooke	Assessing drivers of stream metabolism across gradients of nutrient enrichment in agriculturally affected ecoregions of Alberta.
23	Fielding Montgomery, A Weston, B Rutherford, and Eddie Halfyard	Integrated conservation planning for priority watersheds within the NS Southern Upland Priority Areas.
24	Gabrielle Deveau, Darren Porter, Joseph Beland, and Michael JW Stokesbury	Coastal residency and dietary habits of yellow American eel (Anguilla rostrata) in Minas Basin, Nova Scotia.
25	Daniela Notte, Glenn T Crossin, and David Hardie	Predation of Atlantic salmon smolts migrating out of the Stewiacke River, NS.
26	Graham Raby, Claire Doherty, Ali Mokdad, Trevor Pitcher, and Aaron Fisk	Maximum metabolic rate is underestimated when using a manual chase protocol in salmonids.
27	Morgan Anderson, Trevor Pitcher, and Christine Madliger.	Behavioural and physiological stress metrics in hatchery-reared and aquarium reared Lake Sturgeon..
28	Christine Campbell and Erin Stevens	Shifting zooplankton species composition in St. Pauls Inlet, a brackish lake, reflects wider ecosystem trends.
29	Jennifer Van de Vooren, Brianna Wyn, and Megan Cooley	Coordinated Aquatic Monitoring Program (CAMP): Long-term Aquatic Ecosystem Monitoring in Manitoba.

	Poster Numbers	
Poster	**Authors**	**Title**
30	Jerome Marty and the Volunteers of the Kings County Monitoring program.	Citizen science unveils long-term changes in lake functioning in Kings County, Nova Scotia.
31	Josh Kurek, Paul W MacKeigan, Sarah Veinot, Angella Mercer, and Karen A Kidd	Ecological legacy of DDT archived in lake sediments from eastern Canada.
32	Kristen Coleman, Josh Thienpont, and Jennifer Korosi	Permafrost thaw-mediated lake browning.
33	Lauren Muzak Ruff, Ian Spooner, Mark Mallory, Nic McLellan, Dewey Dunnington, and Julia Crews	A paleolimnological assessment of factors affecting metal deposition and productivity in upland hydroelectric reservoirs, Nova Scotia, Canada.
34	Derek Gray, Mariam Elmarsafy, Jasmina Vucic, Rachel Cohen, Mercedes Huynh, Thomas Pretty, and Matthew Teillet	Which physicochemical variables should zooplankton ecologists measure when they visit a lake?
35	Kayla Tasky, Mariam Elmarsafy, and Derek Gray	Could phenotypic plasticity help zooplankton adjust to climate-driven salinity changes in Great Plains' Lakes?
36	Marcus Rice, Catriona Jones, and Paul Frost	Calcium Stress in Daphnia pulicaria and exposure to predator-derived cues: Making a bad situation worse.
37	Sarah Ellen Johnston, Kerri Finlay, Mackenzie Metz, Robert GM Spencer, David E Butman, Robert Striegl, and Matthew J Bogard	The Chemical Composition of Zooplankton Mediated Dissolved Organic Matter Cycling.

Abstracts

Abstracts are arranged in alphabetical order by title.

A Canadian Case Study Of Using Mobile Technology To Provide A Scalable Alternative To Traditional Creel Surveys and Netting Surveys.   Sean Simmons

Canada has over a million fish bearing lakes and streams, however only a small number of them are monitored each year due to the high cost of traditional survey methods. As a result, the vast majority of fish bearing waters remain unmonitored and potentially at conservation risk. To address this issue Angler's Atlas launched a mobile app and website called MyCatch that encourages anglers to report their catch data. Our first goal was to generate creel data from our app and compare it with results from a traditional creel survey to determine if the results are similar. The first comparison was with a large creel survey done on the Bow River in 2018. Results show a strong correlation with catch rates and with species compositions, and no significant difference was observed. In 2019 we ran a second experiment to determine if we could use our app at tournaments and replicate length data collected from traditional netting surveys. Initial results suggest this method could be widely used at ongoing tournaments, with the added conservation benefit that this is a non-lethal form of sampling as all the fish are quickly released back after being measured. (Oral)

A human impact metric to inform the spatial management of coastal ecosystems.   Grace EP Murphy, Melisa C Wong, and Heike K Lotze

Coastal biogenic habitats are vulnerable to human impacts from both terrestrial and marine realms. Yet the broad spatial scale used in current approaches of quantifying anthropogenic stressors is not relevant to the finer scales affecting most coastal habitats. We developed a standardized human impact metric that includes five bay-scale and four local-scale terrestrial and marine-based impacts to quantify the magnitude of anthropogenic impacts to coastal bays and nearshore habitats. We applied this metric to 180 seagrass beds (Zostera marina), an important biogenic habitat prioritized for marine protection, in 52 bays across Atlantic Canada. Our results show that seagrass beds and coastal bays in Atlantic Canada exist across a wide human impact gradient and provide insight into which are the most and least affected by human threats. We also found high within-bay variation in impact intensity, emphasizing the necessity of quantifying impacts at multiple spatial scales to best inform conservation planning. We discuss how this human impact metric can be used to inform the spatial management of coastal ecosystems. (Oral)

A paleoenvironmental study tracking eutrophication, metal pollution, and climate change in Niven Lake (NT), Yellowknife's first sewage lagoon.   Emily Stewart, Kathryn Hargan, Branaavan Sivarajah, Linda Kimpe, Jules Blais, and John Smol

The City of Yellowknife's first wastewater disposal site, Niven Lake, was actively used from 1948 to 1981 and was also aerially contaminated with arsenic from nearby gold mining operations. Here, we used a high-resolution sediment core to track past sewage inputs to Niven Lake by comparing changes in sedimentary sterols, biological assemblages (diatoms and chironomids), and overall lake production. Coprostanol, often considered the best indicator of human fecal contamination, increased by ~10% between 7.5 cm and 5 cm (~1950 to 1981). Muted responses in subfossil diatom and chironomid assemblages were noted during the time of sewage inputs, as have been reported in other Arctic sites that experienced cultural eutrophication. In the 1990s, a decade after the decommission of Niven Lake as a sewage receptacle, more notable shifts in the biological record occurred, which coincided with the warmest years on record for Yellowknife. Recent climate warming may be partly responsible for chironomid-indicated anoxia via enhancement of the positive feedback of possible internal phosphorus loading. Autecological changes in the biology of Niven Lake were also indicative of metal pollution, though the relative effects of eutrophication and metal contamination are difficult to disentangle. (Oral)

A paleolimnological assessment of factors affecting metal deposition and productivity in upland hydroelectric reservoirs, Nova Scotia, Canada.   Lauren Muzak Ruff, Ian Spooner, Mark Mallory, Nic McLellan, Dewey Dunnington, and Julia Crews

A 200-year paleolimnological study of two upland hydroelectric reservoirs in Nova Scotia provided insights into metal deposition and lake productivity associated with water level change. Black River Lake (BRL)

and Gaspereau Lake (GL) were modified by dam installation beginning in the 1920's and are influenced by similar hydrological and ecological conditions but are morphometrically distinct. Flooding resulted in increased metals (Pb As Zn Sr Ti) which peaked around 1970 in BRL. GL records increases in most metals until present, however, Sr and other grain size dependent elements decreased with flooding. Chlorophyll-a data indicates an increase in productivity during flooding though productivity in BRL increased much earlier than GL. These data suggest that the morphometry of the flooded surface strongly influences the timing of erosion, water column productivity and the composition and concentration of the metal load. The GL Sr record may also reflect the impact of damming on the transfer of nutrients and metals from marine environments to GL by alewife (Alosa pseudoharengus), an anadromous fish. Continuing research focuses on investigating the lake sediment isotopic record (13C 15N) to better resolve the mechanisms controlling metal flux and productivity into these two upland reservoirs. (Poster)

A practical method to account for variation in detection range in acoustic telemetry arrays to accurately quantify the spatial ecology of aquatic animals. Jacob W Brownscombe, Lucas P Griffin, Jacqueline M Chapman, Danielle Morley, Alejandro Acosta, Glenn T Crossin, Sara J Iverson, Aaron J Adams, Steven J Cooke, and Andy J Danylchuk

Acoustic telemetry is a popular tool for long-term tracking of aquatic animals to quantify patterns of movement, space use, and diverse ecological interactions. Acoustic receiver performance in detecting tagged animals often varies greatly over space and time, which can cause error in measures of animal spatial ecology. Despite wide recognition of this, few studies to date account for it. We devised a relatively simple and practical approach to quantify and account for variation in acoustic receiver performance to reveal more accurate patterns in animal spatial ecology, involving the use of select sentinel receiver sites, a range testing procedure, and strategic placement of a reference tag throughout the study. A model is then developed to predict a receiver performance correction factor throughout the acoustic telemetry system over the course of the study, which can be used to correct animal detection data in a variety of ways. This approach, with associated R code for implementation can be accessed here: https://besjournals.onlinelibrary.wiley.com/doi/abs/10.1111/2041-210X.13322 (Oral)

A quantitative review of density-dependence in salmonids: biological mechanisms, methodological biases, and management implications. Jean-Michel Matte, Dylan Fraser, and James Grant

Understanding the complex variation in patterns of density-dependent growth and survival across populations is critical to adaptive fisheries management. Consequently, we conducted a meta-analysis of published literature to investigate the relative importance of methodological and biological predictors on the shape and strength of density-dependent growth and survival in salmonids. We obtained 160 effect sizes from 75 studies of 12 species conducted between 1977-2019 that differed in experimental approach (laboratory experiments, observational studies, and field experiments). The experimental approach was the strongest factor influencing the strength of density-dependence across studies: density-dependent survival was stronger than growth in observational studies, whereas laboratory experiments detected stronger density-dependent growth than survival. The shape of density-dependence (logarithmic, linear, exponential, density-independent) could be predicted reliably based solely on the experimental approach and the density gradient of the study. Overall, the strength and shape of density-dependence were primarily influenced by methodological predictors, while biological factors had predictable but modest effects. For both empirical studies and adaptive fisheries management, we recommend using field experiments with a density gradient of at least 440% to detect the proper shape of the density-dependent response, or by accounting for potential biases if observational or laboratory studies are conducted. (Oral)

Accounting for evolution in fisheries management: no ordinary fish tale. Manuelle Beaudry-Sylvestre, Hugues P Benoît, and Jeffrey A Hutchings

The overarching goal of this project is to support the implementation of evolutionarily-informed fisheries management in the northwest Atlantic. In recent decades, theory and empirical research have raised concerns that fisheries-induced evolution (FIE) could drive long-term reductions in a stock's age and size at maturation, harvestable biomass and potential for recovery following depletion. Comparative analyses have suggested that the rate and magnitude of FIE could be mitigated by reducing harvest intensity and concentrating fishing efforts on spawning aggregations of mature individuals. In a first step, we will assess the need

for such measures in eastern Canadian Atlantic herring by testing the effects of fishing intensity and location on estimated trends in probabilistic maturation reaction norms (PMRNs). In a second step, we will test the rarely challenged assumption that human predators outpace natural selection by examining the role of seal predation in inducing early maturation in depleted groundfish communities. We aim to identify instances where threat elimination fails to reverse FIE and its consequences by comparing temporal trends in PMRNs within and among stocks, species and ecosystems. From an applied perspective, our project will facilitate the communication of practical guidelines to fisheries decision-makers on the precautionary management of evolving resources. (Oral)

Acid rain and salmon recovery: success and expansion of the West River Acid Rain Mitigation Project.   Jillian A Leonard and Edmund A Halfyard

Acid rain, while greatly reduced in some areas since the 1980's, has continued to negatively impact aquatic and terrestrial habitat in Nova Scotia. The survivability of freshwater fish is greatly decreased, as is the abundance of prey items and native plant species that contribute to healthy aquatic ecosystems.

In 2005 the Nova Scotia Salmon Association began an acid rain mitigation project northeast of Halifax on the West River, Sheet Harbour. An automated lime doser continuously administers powdered limestone directly into the acidic river water to raise pH. This reduces the concentration of toxic aluminum and ultimately increases the survival and abundance of Atlantic Salmon and other acid-sensitive aquatic species. Since then, the freshwater production of juvenile Atlantic Salmon has increased by >300% in treated areas of the watershed, and water chemistry is above target levels. Untreated areas continue to show low fish abundance and large areas of vital habitat remain impacted, thus limiting the full recovery of the population.

In 2016 the project expanded to include a second automated doser, aerial terrestrial liming and physical habitat restoration. Early results of these combined efforts have shown positive impacts on soil quality, vegetation and fish abundance. Through partnerships and collaboration, this work will continue to inform Atlantic Salmon recovery strategies and the development of a data-driven model for habitat restoration in the province. (Poster)

Apognmatulti'k: Integrating Mi'kmaw, local, and Western knowledge to enhance aquatic stewardship in Nova Scotia, Canada.   Evelien VanderKloet, Nikki Beauchamp, Megan Bailey, Joseph Beland, Rod Bradford, Lindsay Carroll, Shelley Denny, Gabrielle Deveau, Sara Iverson, Shannon Landovskis, Darren Porter, Michael Stokesbury, and Fred Whoriskey

Canada's Ocean Tracking Network (OTN) has embarked on a 3-year collaborative research project that aims to enable better stewardship of marine resources through equal participation and engagement among Mi'kmaq rights holders, local knowledge holders, and academia to increase understanding of the movements and seasonal habitat use of valued species in the Bay of Fundy and Bras d'Or Lake, Nova Scotia, Canada. The project, Apoqnmatulti'k ("we help each other"), is guided by local and Indigenous (Mi'kmaw) knowledge from the study sites with the goal of better understanding and protecting ecologically and culturally valued species for the surrounding communities. Knowledge co-production, exchange, and capacity-building are central to this project. Project partners contribute to all aspects of the project, from developing the initial proposal, to designing the study objectives and methods, training students and technical personnel, and disseminating project information.

Apoqnmatulti'k places Indigenous partners at the core of the research program and aims to enhance aquatic stewardship by combining the strengths of different knowledge systems to produce community-based results. Data and results will flow through Mi'kmaq communities and technical bodies, as well as government and academic institutions, with the goal of informing co-management approaches for marine resources and support community-based decision-making. (Poster)

Aquatic Ecosystem Senescence of Wetland Impoundments in the Upper Bay of Fundy.   Jacob Demers and Joshua Kurek

The loss of wetlands through human activities has raised the importance of preserving these habitats. We investigate observed declines in primary production, commonly referred to as senescence, in 30 human-managed wetland impoundments in the Upper Bay of Fundy, maritime Canada. Impoundments studied range from

newly restored (<2yrs) to 50 years old. Each impoundment was sampled for macroinvertebrates in emergent vegetation, submerged vegetation, and open water habitats in the spring, summer and fall of 2018. Water chemistry and sediment organic content measurements were also collected for each impoundment. Environmental measures showed that newly restored impoundments were typically the most productive. Macroinvertebrate assemblages displayed statistically significant compositional changes in relation to impoundment age class. Indicator taxa were found to define age class differences. We also examined different sampling efforts of wetland macroinvertebrates to determine optimum and efficient D-net sweeping distance. Preliminary results indicate that increasing from a 1 to 2 meter sweeping distance results in the majority of the diversity increase across all sampling efforts. This research is ongoing and the findings will address how wetland senescence may structure the aquatic environments of impoundments and the ecosystems services they provide. (Oral)

Arctic Salmon: Community-led initiatives monitor increasing salmon in the Canadian Arctic.   Karen Dunmall, Darcy McNicholl, Kevin Gully, Zander Chila, Miranda Bilous, Trevor Lantz, Colin Garroway, and Jim Reist

As expected, warming temperatures are influencing fish distributions and habitats in the Canadian Arctic at an unprecedented rate. Documenting these changes, however, is exceedingly difficult given the remote, harsh Arctic environment and lack of basic information about aquatic species and their habitats at high latitudes. A Canadian Arctic-wide community-based monitoring project, called Arctic Salmon, is documenting increasing abundances and distributions of Pacific salmon (Oncorhynchus spp.), Atlantic salmon (Salmo salar), and other "unusual fishes" in subsistence harvests. Increasing occurrences of salmon, however, may not mean vagrants are establishing new populations in the Canadian Arctic. Using known ecological parameters, we assess the risk of colonization by Pacific and Atlantic salmon in habitats currently occupied by iconic Arctic fishes. We also describe an approach, which can be community-led, to monitor key environmental parameters in critical freshwater habitats for native fishes, and to predict watersheds vulnerable to colonizations by salmon. Engagement with community members documents local and traditional knowledge about salmon and the changing aquatic environments, allowing a better understand of factors influencing biodiversity shifts. By coordinating, sharing, and building upon local, traditional, and scientific knowledge, we can better manage fishery development opportunities and predict impacts on aquatic ecosystems in a future Arctic. (Oral)

Arsenic, chromium, and other elements of concern in fish from remote boreal lakes and rivers: drivers of variation and implications for subsistence consumption.   Gretchen L Lescord, Thomas A Johnston, Matthew Heerschap, Constance M O'Connor, F Meg Southee, Brian A Branfireun, and John M Gunn

Across northern Ontario, various freshwater fish have elevated concentrations of chromium (Cr), arsenic (As), and mercury (Hg), which has invoked consumption limitations issued by the provincial government, a concern for remote First Nation communities which rely on such fish for subsistence. While the drivers of [Hg] have been well studied in boreal fish, less is known about [As], [Cr], or other elements. In this study, we measured 10 elements (including Hg, As, Cr) in 388 fish sampled from 26 sites across northern Ontario to determine the effect of: 1) trophic ecology (e.g. diet via stable isotopes) and 2) watershed geology, the assumed natural source of these elements. Traces of Hg, As, and Cr were detected in most fish, sometimes at elevated concentrations that exceeded their respective advisory benchmarks. Results suggest that Hg and As, but not Cr undergo bioaccumulation. Modeling showed that site-related factors strongly influenced As, Cr, and Se concentrations in fish; however, geological features were not related to piscine elemental content in our dataset, possibly due to the board spatial scale considered. Results from this study address current gaps in our understanding of As, Cr, and Se uptake in fish and will be help refine consumption guidelines. (Poster)

Aspects of Thermal Acclimation in Juvenile Brook Trout (Salvelinus Fontinalis).   Theresa Mackey, Travis Durhack, Jen Jeffrey, Eva Enders, Ken Jeffries, and Caleb Hasler

Rising water temperatures are affecting the health and distribution of aquatic organisms. Brook trout (Salvelinus fontinalis), a freshwater species adapted to cooler environments, is a popular sport fish, and at risk to high temperature due to its habitat preference. Using five acclimation temperatures, we aimed to

quantify the stress response of juvenile brook trout by collecting physiological and molecular parameters to understand the processes that occur when these fish are stressed. Further, we aimed to understand the effect of acclimation temperature on their recovery when exposed to acute stress events that simulate the paired stressors of exhaustive exercise and air exposure induced by catch-and-release angling. We predicted that exposure to acclimation temperatures beyond those to be preferred by brook trout caused individuals to exhibit an increased stress response and increased recovery duration. Using qPCR methods, we quantified gene expression and other physiological markers associated with stress and temperature-induced cellular mechanisms to aid in the identification of a sub-lethal temperature threshold for this species. Our study results are imperative in understanding the implication of global climate change on future brook trout populations and will be useful for managing fish habitat and regulating recreational fishing. (Oral)

Assessing community concordance metrics for assessing anthropogenic land use effects on aquatic ecosystem integrity in the North Saskatchewan River. Victoria Van Mierlo and Mark Poesch

Aquatic biomonitoring is a powerful tool in freshwater conservation. Community concordance is a metric for assessing aquatic ecosystem health that describes the similarity between ecological community patterns along natural and degradation gradients. Traditionally, the concordance of riverine fish and macroinvertebrate assemblages has been assessed taxonomically, and more recently, functionally (feeding type, habitat preference, and life history). These studies have identified drivers of impairment and impacts of anthropogenic land use on lotic systems, globally. Despite the economic and ecological value of Albertan river systems, no studies have yet assessed community concordance as a metric for assessing anthropogenic land use effects on lotic aquatic ecosystem integrity. One of Alberta's most valuable and impacted basins is the North Saskatchewan River (NSR) basin. This study aims (1) to assess fish and macroinvertebrate community concordance taxonomically and functionally among NSR tributaries; (2) assess the efficacy of concordance to describe drivers of aquatic impairment in the NSR; and (3) determine the relationships between major drivers of aquatic impairment and anthropogenic land use types of the NSR watershed. Information gained will contribute to the creation of a novel geospatial modelling tool that will result in more cost and time efficient management of the NSR watershed. (Poster)

Assessing drivers of stream metabolism across gradients of nutrient enrichment in agriculturally affected ecoregions of Alberta. Emily J Barrie, Gregory S Piorkowski, Suzanne E Tank, and Rolf D Vinebrooke

Aquatic ecosystems are essential for agriculture, industry and recreation. However, many streams have been impacted by non-point source nitrogen and phosphorus pollution across much of Alberta's agricultural regions. Despite this, the effect of nutrient enrichment on the ecological functioning of small Albertan streams is relatively unknown. Here, we assess how stream metabolism varies across nutrient gradients within Alberta's Boreal, Parkland, and Grassland ecoregions, each of which have been affected by substantial agricultural activity. Stream metabolism was assessed in twelve streams within each ecoregion using 4-5 day sensor deployments in each of the spring, summer and fall seasons. Metrics of stream metabolism were calculated using in situ measurements of dissolved oxygen, temperature, and light, and compared against within-stream nutrient concentrations and physical characteristics of the stream and watershed. Across all sites, average GPP ranges from 0.18 to 8.70 g O2 m-2 d-1, while ER ranged from -16.46 to -0.51 O2 m-2 d-1. GPP tends to increase with ER and NEP is generally negative. Both of these metrics varied seasonally and across ecoregions. The results of this project can be used to inform water quality management plans in Alberta, enabling individual ecoregions to have specific nutrient criteria. (Poster)

Assessing genomic vulnerability to climate change in Canada's northernmost freshwater fish, Arctic charr. Kara KS Layton, Paul VR Snelgrove, J. Brian Dempson, Tony Kess, Sarah J Lehnert, Paul Bentzen, Steven J Duffy, Amber M Messmer, Sarah J Salisbury, Daniel E Ruzzante, Ryan RE Stanley, Claudio DiBacco, Cameron M Nugent, Moira M Ferguson, Jong S Leong, Ben F Koop, and Ian R Bradbury

Efforts to sustain biodiversity require an understanding of how species will respond to future climate change, but this remains largely unknown in many commercially and ecologically important northern taxa. Here, we assess the spatiotemporal response of Arctic charr to climate change in northeastern Canada, a region experiencing unprecedented rates of warming. First we use genomic vulnerability, defined as the magnitude

of shifts in allele frequencies required to track climate change projections, to identify populations that are especially vulnerable to future climate change. Then, to determine whether climate change is linked to population declines in Arctic charr, we use estimates of historical effective population size and decades of environmental data from the region to look for past climate-associated declines. We find that genomic vulnerability follows a latitudinal cline and is highest in southernmost populations, and that a past range-wide decline corresponds to a climate anomaly and decreases in community biomass in the northwest Atlantic. This study demonstrates the importance of integrating genomic and environmental data for predicting how species will respond to climate change and it suggests that highly vulnerable southern populations of Arctic charr are susceptible to decline. The results reported here have significant implications for the future management and conservation of this exploited northern fish species. (Oral)

Assessing the impacts of Dorset Palaeoeskimo on freshwater ecosystems at Port au Choix, Newfoundland using paleolimnology. Kristen Coleman, Neal Michelutti, Trevor Bell, Jules Blais, and John Smol

The Northern Peninsula Archaeology and Landscape History Program is a collaboration between archaeologists and environmental scientists with a focus on assessing the occupation and abandonment of the Dorset Paleoeskimo culture at Phillip's Garden (NL), the most southerly of all the known Dorset settlements. Here we used paleolimnological analyses of lakes in the Port au Choix area to reconstruct past environmental conditions, to determine possible environmental causes that might have led to site abandonment, and examine the ecological impacts of the Dorset people on nearby aquatic ecosystems. Artifacts found in the catchment of Bass Pond, the nearest water body to the settlement, suggest this may have been a site of seal processing activities. Although possible environmental causes for site abandonment were not identified, past ecosystem disturbance in Bass Pond, characterized by increased primary production, changing nutrient inputs, and a shift in aquatic ecology was detected using several paleolimnological proxies. This disturbance was not observed in sediment cores obtained from nearby reference lakes. Although archeological evidence suggests that the Dorset occupation was larger and much more intensive than previous cultures at Phillip's Garden, carbon dating suggests that the ecosystem disturbance observed in the Bass Pond sediment core predates the Dorset occupation. (Oral)

Assessing the impacts of threats to the survival of the Plains Sucker (Pantosteus jordani) in the Milk River. Taylor MacLeod, Mark Poesch, Eva Enders, Doug Watkinson, and Kieth Tierney

The Plains Sucker is a newly identified species of catostomid that is considered "threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). It resides in the Milk River of the Missouri drainage, which eventually empties into the Gulf of Mexico. Waterway augmentation is considered by COSEWIC to be one of the largest threats to the Plains Sucker's survival. During spring and summer melt, 20m3/s of water is transferred from the St. Mary River into the Milk River of the Missouri Drainage. A swim tunnel was used to examine the Plains Sucker's ability to maintain position at increasing water velocities. Measurements of fecundity and length/weight-at-age were used to assess evidence of an energetic trade-off among life history characteristics. These tests and results are compared between the augmented Milk River and waterbodies that do not experience augmentation. Early findings suggest a plastic response in Plains Sucker to augmentation in the Milk River. The experimental measurements of this project, and life history measurements taken from the fish collected, will contribute to filling large knowledge gaps on this species in Canada and provide focus for recovery planning measures to preserve the Plains Sucker in its natural habitat. (Oral)

Baited Remote Underwater Video (BRUV) to assess fish and invertebrate community structure in the Estuary and Gulf of St. Lawrence. Safouane Khamassi, Marie-Julie Roux, and Dominique Robert

Baited Remote Underwater Video (BRUV) systems offer versatile and non-intrusive methods for studying fish and invertebrate species in their natural habitat, while minimizing the impact of scientific data collection on organisms and marine environment. In the Estuary and Gulf of St. Lawrence (EGSL), trawl surveys and commercial fisheries sampling are the main source for collecting biological data. These data are spatially limited due to rugged seabed, as well as temporally limited to the summer season, owing to the presence of sea ice during the winter period. Our main objective is to address this knowledge gap and develop BRUV

systems into a reliable tool to inform stock assessments and ecosystem-based management. To validate video sampling, we compare BRUVs to traditional sampling gear such as beam trawls and fyke nets. Using BRUV data, we develop methods to quantify relative abundance, size structure, diversity and habitat use by fish and invertebrate species. Then, we will assess community structure, the use of benthic and demersal habitat, and seasonal variations in species distribution in the EGSL. In the context of changing oceanographic conditions such as rapid warming and oxygen depletion, we see a great advantage in resorting to new technologies such as BRUV systems. (Poster)

Behavioural and physiological stress metrics in hatchery-reared and aquarium reared Lake Sturgeon.. Morgan Anderson, Trevor Pitcher, and Christine Madliger.

Fish being reared in standardized hatchery conditions are often exposed to relatively few external elements of stress, as their environments are supposed to be strictly monitored and controlled. Hatchery-based fish have limited interactions with people and stressors such as startling, intense light and noise levels. With public interest towards aquatic conservation and education peaking, the drive to include species at risk in public aquatic education displays has increased greatly. Relatively few studies have been conducted on potential stress fish face when being introduced to external stimulus', such as being startled through the glass from patron interaction, high light levels or loud noises from surrounding areas. In this study, we will compare a variety of stress related metrics in juvenile Lake Sturgeon (Acipenser fulvescens) held in (1) standardized hatchery settings (tanks with no windows and limited human interaction) and (2) a more typical aquarium display – windowed tank with background noises to mimic potential stressors. Collection of blood samples and behavioural data to test the null hypothesis that there is no difference in stress related metrics in our two treatments. This research will provide fundamental information regarding potential stress in public displays and manners which this stress can be minimized with enrichment. (Poster)

Beyond hybridization: five years of genetic monitoring following a large escape of farmed salmon in southern Newfoundland indicates continued introgression. Melissa Holborn, Steve Duffy, Amber Messmer, Tony Kess, Brian Dempson, Paul Bentzen, and Ian Bradbury

The escape of domestic Atlantic salmon (Salmo salar) from aquaculture facilities can directly impact both the genetic integrity and demographic stability of wild populations, and has been identified as a significant threat to the persistence of Atlantic salmon in the wild. In southern Newfoundland a large escape event was documented in 2013, with recent evidence of extensive hybridization with wild individuals and reduced survival of hybrids in the wild. However, the long-term genetic impacts of large escape events such as this remain unclear. Here we analyze five years of ongoing genetic monitoring for hybridization and introgression between wild and domestic salmon using juvenile salmon collected from 18 rivers in southern Newfoundland between 2014 and 2018. Sampled individuals were assigned to hybrid class using a panel of 191 collectively diagnostic SNPs. Initial results indicate a general decrease in F1 hybrids over time, and an increase in the proportion of wild-backcross hybrids. The results suggest that despite decreased survival of F1 hybrids in a wild environment, precocially maturing male F1 hybrids are successfully mating with returning wild females. This work suggests that introgression between wild and domestic salmon may be fast-tracked by precocial male maturation and that introgression between domestic and wild salmon is well underway in southern Newfoundland. (Oral)

Beyond the next horizon: an open dialogue on the future of marine spatial planning in Canada's oceans. Noreen Kelly and Ryan Stanley

The final time-slot for this symposium will be used to discuss and debate the future needs for scientific research in the field of marine spatial planning. This real-time discussion will be hosted by the co-chairs of the symposium (Kelly, Stanley) and 1 or 2 additional researchers, invited based on their participation throughout the symposium. This dialogue will open with a summary of the key messages from presentations given throughout the course of this session, and follow with an open exchange of ideas that may centre on key themes, such as: (a) research needed for the successful implementation of marine spatial planning in Canada by 2030; (b) new technologies needed to conduct this work and how to implement them; (c) the skills required for the next generation of scientific researchers entering the field of marine spatial planning; and/or (d) how to catalyze collaboration among ocean researchers (Government, Academia, NGOs). Other important topics that emerge during the course of the symposium may also be highlighted during the discussion period.

Outcomes from this discussion may be used to form the production of a guidance document that will be published in an open access format. (Oral)

Borrowing from paleontology, art and engineering: presenting a novel method to create artificial habitats using 3D printing and casting techniques. Aneri Garg and Stephanie Green

Habitat selection in aquatic ecosystems is a dynamic process, however the extent to which species use biological cues vs. structural cues associated with biogenic habitats remains unclear. A variety of laboratory, mesocosm and field studies have employed the use of artificial habitats to discern the relative importance of habitat selection cues by key species to habitat. To date, one of the major limitations in the design of artificial habitats is the wide variety materials and structures used in their creation -making them difficult to standardize and thus compare. In this study we propose a set of metrics that can be applied to the design of artificial habitats. These metrics take into account both the design feasibility and design quality of artificial habitats to incorporate materials and methods that are: 1) accessible, 2) scale-able and, 3) of high ecological quality. We also propose a novel method that uses 3D printing and casting that meets these 3 design requirements, and present preliminary results of a field experiment that applies this method to study habitat selection cues of reef fishes to coral reefs. This novel methodology has implications both to better understand ecological mechanisms of habitat selection and retention, and for conservation management to identify habitat characteristics that can be incorporated into potential ecosystem restoration activities. (Oral)

Calcium Stress in Daphnia pulicaria and exposure to predator-derived cues: Making a bad situation worse. Marcus Rice, Catriona Jones, and Paul Frost

Calcium concentrations [Ca] in various lakes on the Canadian Shield have been declining for over 20 years. With [Ca] in many lakes below 2.0 mg/L, there are concerns about possible ecological effects on zooplankton communities. These effects could change with other stressors, including the presence of predators. Here we examined whether effects of low [Ca] on Daphnia pulicaria vary with the presence of invertebrate predator kairomones. We compared the growth rates, necktooth induction, body Ca content, life-history traits and survival of Daphnia exposed to a range of [Ca] with or without kairomones derived from Chaoborus. While kairomone exposure reduced Daphnia growth, these effects did not vary with media [Ca]. However, kairomone exposure reduced reproduction produced by low [Ca]. As expected, kairomones also resulted in more neckteeth in juvenile Daphnia but was more apparent at low [Ca]. Kairomone exposure also increased body %Ca but only in Daphnia grown under low media [Ca]. Our results demonstrate that low Ca conditions and kairomones can interactively affect life-history and body elemental composition of D.pulicaria. Given the ubiquity of Chaoborus in low [Ca] lakes, there is a need to more fully examine how zooplankton responses to low [Ca] interact with predation and other environmental stresses. (Poster)

Case study of Chinese mystery snail, Cipangopaludina chinensis, reveals new insights into gaps in freshwater quality monitoring programs in Nova Scotia. Sarah Kingsbury, Andrew Sinclair, Jason LeBlance, Trevor Avery, and Linda Campbell

Long-term, connistent, and accurate water quality monitoring data is essential to form a strong base of numerous types of research (e.g., species at risk habitat monitoring, invasive species distribution predictions, recreational water health & safety). Here we present our findings of the collection and use of surface freshwater quality data for creating a predictive species distribution model in Nova Scotia for a potentially invasive species, the Chinese mystery snail, Cipangopaludina chinensis. Ten different datasets were combined from a variety of sources (federal and provincial governments, citizen groups, published literature, NGOs, in-person surveys, Google Maps, etc.) in relation to 250 freshwater bodies for 16 water quality parameters, six geographic parameters, four species specific parameters, and four recreational freshwater use parameters (total of 32 parameters) using data from the year 2000 onward. Our results indicate geographic gaps in water quality monitoring programs, inconsistencies in sampling frequency and data reporting quality, and a lack of available data for certain parameters. Although this database was compiled specifically for invasive snail modeling, our results indicate that there are opportunities for improving water quality monitoring frameworks across Nova Scotia. (Poster)

Chromosomal inversions in the Atlantic cod genome: implications for management of Canada's Northern cod stock.. Gregory Neils Puncher, Sherrylynn Rowe; George A Rose, Nathalie M Leblanc,

Geneviève J Parent, Yanjun Wang, and Scott A Pavey.

Canada's Atlantic Cod fishery collapsed in the 80's and 90's and has yet to bounce back. It is essential to understand past and present genetic patterns of populations in order to manage the fishery to return to the former abundance. To test the extent to which cod from different areas mix together, we used next-generation sequencing (ddRAD) on 135 adults captured in 2015 at three offshore spawning locations spanning the range of the offshore stock along the northeastern Newfoundland and Labrador shelf (Hawke Channel, Notre Dame Channel and Bonavista Corridor), with an additional 105 adults from three more southern locations (St. Anns Bank, Browns Bank and Bay of Fundy). Population structure analysis using 5,077 single nucleotide polymorphisms (SNPs) detected a distinct genetic break off the coast of Nova Scotia near 45°N. Gene flow between groups north and south of this divide appears to be limited despite the presence of several northern-type and admixed individuals present in the southern area. All populations have different allele frequencies of a chromosomal inversion, or supergene, on the first chromosome. This supergene contains many genes that may be co-adapted and may be important for different life history strategies. The unusual genetic patterns in Atlantic cod must be considered for successful management (Oral)

Citizen science unveils long-term changes in lake functioning in Kings County, Nova Scotia. Jerome Marty and the Volunteers of the Kings County Monitoring program.

For more than 20 years, volunteers from Kings County, Nova Scotia have been collecting water quality data to assess and monitor the health of 13 lakes. The lakes are mostly humic, with low conductivity, and high dissolved organic carbon content (above 10 mg/L). To assess lake health, the Water Quality Index (WQI), developed by the Canadian Council of Ministers of Environment (CCME) for clear water lakes was adapted for the coloured lakes of the County. In recent years, based on the WQI, water quality has ranged from poor to excellent, with most of the low rating values related to exceedances in Chlorophyll a concentration (above 2.5 µg/L). This was observed despite no significant change in total phosphorus or total nitrogen concentrations. This suggests that other drivers such as temperature and longer ice-free periods explain the increase in primary production. This study demonstrates the value of citizen science in tracking long-term changes in lake functioning. (Poster)

Climate and the Black Swan in Arctic fish populations. Ross Tallman, Kendra Imrie, Gabrielle Grenier, Samantha Fulton, Zoya Martin, Les Harris, and Simon Wiley

Climate change is predicted to be the most pronounced in the Arctic. The dynamics of Arctic fish stocks are already driven by climatic effects in terms of the influence of temperature on vital rates, migration and habitat quality and access. The determining the vulnerability of fish stocks to climate effects will be complicated with information needed on both the sensitivity of species and their likelihood of exposure. We present preliminary results of a fish stock climate vulnerability assessment. We also present direct evidence of climate effects on the biology of Arctic Charr in terms of changes in trophic ecology and early life history. Arctic Charr in Cumberland Sound altered their diet from invertebrates to more fish oriented consumption concurrent with the invasion and establishment of a temperate species, Capelin. Study of the growth patterns in the early life history using back-calculation techniques suggest that climate effects influence early growth which may result in changes to the dynamics of stocks. Finally, we discuss the problem of "Black Swan" events in natural resource population dynamics. (Oral)

Climbing the wall: Evaluation of American Eel Interactions with Low-Overhead Dams. Brandon R Nilsen, Aaron Spare, Nic R McLellan, Trevor S Avery, and Michael JW Stokesbury

The American eel has an extensive range along the Atlantic coast of North America. Despite their extensive range, eel have recently experienced dramatic declines in some areas due to reduced access to freshwater habitat and overall habitat fragmentation which have been identified as contributing factors to decreases in recruitment of elvers (juvenile eel). Attempts to improve access have included the use of passage enhancement devices that have frequently been deployed in Europe and at large-scale hydroelectric dams in North America. We observed that low-overhead dams equipped with small scale pool-and-weir and Denil style fishways present barriers for upstream migration of elvers. We then tested four low-cost passage enhancement devices to determine their effectiveness for increasing elver passage. In 2018, we characterized the obstruction of upstream passage at overhead dams and both pool-and-weir and Denil style fishways through dip-net surveys, modified pitfall traps and by observation. In 2019, we documented passage counts for four styles of passage

enhancement devices, including ramp and vertical passes. All four passage devices enabled the upstream passage of elvers. Passage designs were effective in facilitating upstream movement for different size-and-age classes of eel. We identified four low-cost passage enhancement solutions to counteract the effects of riverine obstructions for migratory freshwater elvers. Additional work is required to determine the internal passage efficiencies and optimal installation conditions for each device type. (Oral)

Clupea harengus: Reciprocal transplant of spring and fall spawning herring. James Kho, M Lisette Delgado, Gregory McCracken, Jenna Munden, and Daniel E Ruzzante

Our understanding of population structure for pelagic fish in the ocean is largely due to extensive work done on Clupea harengus (Atlantic herring). Atlantic herring is a coastal pelagic fish that has ecological and economical significance for organisms in and around the Atlantic Ocean. Genetics has allowed us to better understand the complex metapopulation of Atlantic herring including the genetic basis of spawning time and the importance of larval stage survival in shaping local populations. Despite its seemingly healthy population status, herring local populations (particularly spring spawning herring) are declining. The main objective of this ongoing study is to better understand the mechanism that spawning time plays in local population dynamics. I will focus on gene expression and epigenetics of spring and fall spawning herring under different temperature and light treatments. The fall spawning herring experiment has concluded, and the spring spawning herring experiment will be done in early summer of 2020. Preliminary results of the larval rearing experiment suggest that fall spawning herring larvae appear to survive better in 11°C and 6h daylight conditions. Downstream analyses include RNA sequencing and DNA methylation which will be done in spring. (Poster)

Coastal residency and dietary habits of yellow American eel (Anguilla rostrata) in Minas Basin, Nova Scotia. Gabrielle Deveau, Darren Porter, Joseph Beland, and Michael JW Stokesbury

Spawning in the Sargasso Sea, American eels (Anguilla rostrata) travel thousands of kilometres into fresh, estuarine, and marine waters along the western North Atlantic Ocean coastline. Often more than 20 years later, they begin their seaward migration back to their natal spawning grounds. Eels play an important ecological role in aquatic communities, both as predator and prey, and are harvested in commercial, recreational, and subsistence fisheries. American eels are culturally significant to Mi'kmaw First Nations communities in Nova Scotia, serving as an important food source and are used in traditional medicine. Declines in American eel abundance has occurred in recent years due to a culmination of factors, including migration barriers, turbine mortalities, changing marine conditions, and the over-harvesting of elvers and glass eels. They once accounted for a significant portion of the fish biomass in the Minas Basin, a highly productive, macrotidal area of the Bay of Fundy. As part of a collaborative project between Mi'kmaw knowledge holders, harvesters, academia, community partners, and government, our research will examine coastal residency and feeding preferences of American eels in Minas Basin, Nova Scotia. Movement patterns will be studied using acoustic tracking technology, which includes the use of a pre-existing array of receivers that will provide coverage of riverine, estuarine, and marine habitats. Understanding their behaviour within this region may help identify or avoid conflicts with humans. Feeding habits will also be examined through the visual identification of prey from stomach samples collected throughout 2020-2021. Baseline information on preferred food sources and habitat use may help to guide in the protection of important foraging habitats. Results from this study will be used to enhance co-management approaches and strategies for marine resources in the Minas Basin region. (Poster)

Combined effects of maternal traits and spring warming patterns on spawning success of walleye. Sara Lehman, Tom Johnston, and John Gunn

Shifts in age and size structure of spawning stocks due to exploitation, and alterations in environmental conditions caused by climate change are two factors that may impact spawning success and recruitment in fish populations. We examined the roles of female traits and incubation temperature regimes on spawning success of a highly-exploited, spring broadcast-spawner, walleye. In each of three spawning seasons (2017 − 2019) of a single spawning stock (Lake Nipissing) we fertilized eggs of individual females collected on multiple dates over the spawning period. Lengths and ages of the females, and sizes and lipid compositions of their ova were determined. Individual females' egg batches were reared to hatch in flow-through incubation systems under three spring warming treatments (slow, medium, rapid). For each year, embryonic survival and time

to hatch are being modelled as functions of spawning date, incubation warming rate, and maternal and ova traits. Though analyses are ongoing, preliminary results indicate that both spawning date and female traits influence survival to hatch, whereas incubation warming rate has a strong effect on time to hatch but not survival. Interestingly, and contrary to earlier research on other walleye stocks, embryonic survival does not appear to increase with maternal age. (Oral)

Community size spectra provide indicators within recovering fisheries ecosystems on the Newfoundland and Labrador shelf. Kyle J Krumsick and Jonathan AD Fisher

Species- and size-selective overexploitation often have ecosystem-wide impacts that are evident in community size-spectra. To both derive potential ecosystem targets for community rebuilding and assess contemporary indicators relative to these targets, we constructed theoretical size-spectra to predict pristine biomass densities using a combination of species- and size-specific nitrogen stable isotope signatures and a range of trophic efficiencies and primary productivity estimates within and among three sub-regions of the Newfoundland and Labrador shelf. Theoretical size-spectra were compared to empirically-derived size spectra using trawl survey data. The descending slopes of the empirically determined size spectra were between 1.25 and 2.42 times steeper than the theoretical slopes. The percentage of the theoretical distribution represented by the empirical size structure ranged between 1.1 and 29.4% and were strongly influenced by estimates of trophic efficiency and primary productivity. Regional variation was also observed with southern regions reaching $1.3 - 32.3\%$ of the theoretical biomass density and the northernmost region only $0 - 8.3\%$. The descending slopes varied depending on fish size, with biomass density of larger sizes decreasing faster than smaller sizes. These analyses provide a means to derive potential ecosystem targets and indicators through which recovery of fish communities can be monitored and assessed. (Oral)

Comparing fish populations in shallow northern boreal lakes using mobile hydro-acoustic surveys: Benefits and biases. Sebastian Theis, Mark Poesch, Dak de Kerckhove, and Cameron Stevens

The need for fishery independent data in regards to stock assessment and implementation of management strategies has increased at a rapid rate over the past few decades (Fernandes et al. 2000), with hydro acoustic surveys taking the center stage. Mobile hydro acoustic surveys conducted from research vessels potentially still introduce a variety of biases like vessel avoidance (Wheeland and Rose 2014), nearfield exclusion (Baran 2017) or missing diurnal movement patterns (Lian et al. 2013). To investigate these potential biases our research aims to conduct vessel avoidance studies and compare fish distribution and abundance in day and night surveys, as well as using a combination of side and downward facing scans to capture the whole of the depth profile in shallow northern boreal lake systems. Results backed by conventional gill netting show how biomass estimates differ among target species and between lakes in regards to environmental variables and survey times. Overall our ongoing studies underline the importance of improving hydro-acoustic survey sampling techniques to more accurately assess whole ecosystem populations and maximize benefits from mobile surveys. (Poster)

Connectivity and migratory movements of Greenland Halibut from Greenland coast in Northwestern Atlantic. Laélien Bassi, Réjean Tremblay, and Pascal Sirios

Greenland Halibut (Reinhardtius hippoglossoides) is a deepwater flatfish species with a circumpolar distribution that significantly supports the fishing industry of the Northwestern Atlantic. Knowledge of spatial connectivity and migratory patterns of commercial species are indispensable in order to carry out a sustainable fishery, but these fields remain poorly understood in this species. This study aims to identify connectivity and the potential exchange of individuals between the Greenland and Canadian coasts to ultimately characterize the contribution of each region to different stocks and/or populations in the Northwestern Atlantic. Connectivity for each fish were established by measuring chemical element concentrations in the sagittal otolith margins and core using LA-ICP-MS. An elemental fingerprint is recorded, by accretion, in the otoliths throughout the life of the individual and varies according to the chemical nature of different water masses in which the fish inhabits. Elemental fingerprint in otolith margins served as a baseline reference to assess the chemical signature in the otolith core which corresponds to the fish's origin. Here, we focused on Greenland-caught individuals and showed that the majority of Greenland halibut sampled in Greenland regions have the same origin: Hellefiske Bank. (Oral)

Coordinated Aquatic Monitoring Program (CAMP): Long-term Aquatic Ecosystem Monitoring in Manitoba. Jennifer Van de Vooren, Brianna Wyn, and Megan Cooley

Manitoba/Manitoba Hydro's Coordinated Aquatic Monitoring Program (CAMP) is a long-term partnership program designed to assess conditions in lakes and rivers affected by Manitoba Hydro's generating system, as well as waterbodies located off the MH hydraulic system. The impetus for the program arose following public hearings for new generating facilities, where it was noted that current investigations addressed site-specific issues but there was no comprehensive, system-wide program to evaluate the health of the affected lakes and rivers. CAMP sampling began in 2008 and includes monitoring of water and sediment quality, phytoplankton, benthic macroinvertebrates, fish, fish mercury, and habitat in over forty waterbodies in Manitoba. The primary objective of CAMP is to monitor for long-term trends in aquatic ecosystem health across Manitoba Hydro's hydraulic system. The data collected under CAMP have been used in a range of applications (e.g., status and trend reporting, environmental impact assessment, support for other aquatic monitoring programs, academic research, primary research publications) and by various organizations (e.g.,regulators, university researchers, students, consultants, Indigenous communities). The program provides a unique opportunity to evaluate large, comprehensive, long-term, and geographically broad ecological data sets that have been generated through use of standardized methods. (Poster)

Could phenotypic plasticity help zooplankton adjust to climate-driven salinity changes in Great Plains' Lakes? Kayla Tasky, Mariam Elmarsafy, and Derek Gray

Climate change is expected to lead to increased aridity in the northern portion of the North American Great Plains, influencing lake salinity levels. Zooplankton are known to be sensitive to changes in salinity levels, but little is known about plasticity in osmoregulation for common species in the region. For this study, I examined whether the zooplankter, Ceriodaphnia dubia, was able to tolerate gradual increases in salinity levels. Cultures of C. dubia hatched from eggs collected from Moon Lake (North Dakota, USA) in depth layers associated with either fresh or salty periods of the lake's history were established. These cultures were used in salinity tolerance experiments to determine: 1) If EC50 values (salinity level causing 50% immobility) differed between gradual and traditional toxicity experiments; and 2) If salinity tolerance of C. dubia differed if eggs used to establish cultures were deposited during times of high versus low salinity. Preliminary results indicate that C. dubia can survive only small increases in salinity (2-3 mg/L) over the course of their lifetime, suggesting that plasticity would only play a minor role in allowing the species to remain in systems that experience the large fluctuations suggested by paleolimnological work (>10 mg/L). However, there were small, but significant differences in salinity tolerance between individual depth layers suggesting that the species has been able to evolve in response to changing salinity levels in the past. (Poster)

Current and emerging statistical techniques for aquatic telemetry data: A guide to analysing spatially discrete animal detections. Kim Whoriskey, Eduardo G Martins, Marie Auger-Méthé, Lee FG Gutowsky, Robert J Lennox, Steven J Cooke, Michael Power, and Joanna Mills Flemming

Telemetry technology has vastly enhanced our ability to study the spatial ecology of aquatic animals, shedding new light into the management and conservation of fish and fisheries stocks. Statistical analysis of telemetry data has necessarily evolved to keep up with the increasingly complex studies designed for these species, but there have been no effective syntheses of existing and emerging methods. We reviewed available statistical methods and comment on future directions for analyzing detection data derived from fixed telemetry receiver arrays. We illustrate how these methods can achieve diverse study objectives by providing a case study dataset collected by an array of 42 acoustic telemetry receivers on 187 bull trout in the Kinbasket Reservoir of British Columbia. Finally, we present a decision tree for guiding the selection of an advanced statistical method based on study objectives and sampling design. This review enables telemetry researchers to conduct more comprehensive analysis of detection data and, in so doing, ask a wide variety of ecological questions that will enhance our understanding of how aquatic animals interact with each other, their environment, and humans in a rapidly changing world. (Oral)

Detecting Brook Trout (Salvelinus fontinalis) Seasonal Habitat Use in Haliburton County, ON Using Environmental DNA. Karl Weise

Brook trout (Salvelinus fontinalis) are declining across Ontario in both numbers and range, prompting

concern for their future. Here I combine conventional, new, and predictive tools to document brook trout presence, absence, and seasonal habitat use for management, using streams in Haliburton County, ON as a model system. By combining the Ministry of Natural Resources and Forestry's Aquatic Ecosystem Classification (AEC) system with field validation of physical stream characteristics, backpack electrofishing, and environmental DNA (eDNA) sampling, my research supports the development of AEC modelling and eDNA as tools to document brook trout occurrences. To do this I classified streams as high, moderate, and low-quality brook trout habitats in the AEC to examine it as a predictive tool, and sampled them seasonally with eDNA. To validate eDNA as an effective tool in the Canadian Shield, I used backpack electrofishing as a comparison. Results show eDNA to be an effective tool at monitoring fish across Canadian Shield landscapes and that brook trout display differing seasonal movement within and across watersheds; suggesting management strategies need to incorporate seasonal movement and connectivity. Incorporating these tools will enable biologists to predict and document brook trout occurrences across the landscape with minimal time, cost, and effort. (Poster)

Distinguishing natal habitat of Newfoundland Capelin (Mallotus villosus) using otolith microchemistry. Ashley Tripp, Hannah Murphy, and Gail Davoren

Identifying natal origin of animals is vital for understanding the relative productivity of natal sites and dispersal among sites (connectivity). Given the high dispersal potential and small size of marine fish larvae, natural tags, such as otolith trace element concentrations, are often used to identify natal origin. Capelin (Mallotus villosus) is a key forage fish species on the Newfoundland Shelf that collapsed in 1991 and has not recovered. Capelin spawn in embayments along the northeast and southern coasts of Newfoundland and natal origins of the capelin stock are unknown. We investigated whether larval capelin otolith chemistry differs spatially and temporally across embayments. Capelin larvae were either field-reared or sampled as pre-emergent larvae from spawning beach sediments in Notre Dame Bay (2014, 2015, 2018, 2019), Trinity Bay (2018, 2019), Placentia Bay (2019), St. Mary's Bay (2019), and Witless Bay (2019). Trace element concentrations (e.g., Mg, Mn, Zn, Sr, Ba) in sagittal otoliths were quantified using Laser Ablation Inductively Coupled Plasma-Mass Spectrometry (LA ICP-MS). Larval capelin displayed region-specific otolith chemical signatures with high classification success (70-88%), despite inter-annual variation within regions. These findings suggest that quantifying chemical signatures in the core of adult otoliths could be used to determine natal origin and, thus, quantify region-specific productivity. (Oral)

Divergent supergene explains age of seaward migration in multiple lineages of Atlantic salmon. SJ Lehnert, T Kess, KKS Layton, P Bentzen, I Paterson, N Barson, MP Kent, S Lien, JB Dempson, and IR Bradbury

Atlantic salmon (Salmo salar) exhibit remarkable diversity in life history strategies, yet the genetic basis of many traits is poorly understood. Here, using multilocus association analysis, we identify a 4-Mbp region on chromosome Ssa18 associated with age of seaward migration (smolt age). This genomic region shows patterns of differentiation and linkage disequilibrium consistent with a complex chromosomal inversion across the North Atlantic (n=139 populations) with an ancestral allele shared between continents that is significantly associated with smolt age, summer temperature, and latitude. However, continent-specific relationships differ in magnitude, direction, and dominance patterns, suggesting a role for epistasis and/or gene-by-environment interactions. The Ssa18 inversion contains genes with known roles in circadian rhythm, growth, olfaction, and photoreception, and likely acts as a supergene that influences age of seaward migration. (Poster)

Do regime shifts beget regime shifts? Cod, fishing, and the environment.. Jeffrey A Hutchings, Esben M Olsen, and Tommi Perälä

Regime shifts (RSs) permeate the ecological and fisheries literature. However, definitions vary and most methods used to detect RSs are highly subjective. We employ an alternative, operationally objective means of identifying RSs, using a Bayesian online change-point detection (BOCPD) algorithm able to simultaneously detect shifts in the mean and(or) variance of a time series. We applied the BOCPD algorithm to detect RSs in a century-long time series of Atlantic cod catch rates (from the Norwegian Skagerrak) and RSs in hypothesized drivers of cod productivity. We find that fishing mortality ('F') is of over-arching importance in sensitizing cod to RSs in the North Atlantic Oscillation, zooplankton abundance, and temperature. In southern coastal Norway, high 'F' coupled with small population size, and increased summer and autumn

temperatures that broach the species' thermal limit, are major factors in limiting cod recovery. Of broader significance, we conclude that: (1) the effect of an environmental or climate-related RS on biological productivity is accentuated when it coincides with other RSs; and (2) climate-related RSs are more likely to affect populations when populations are low in abundance. (Oral)

Does personality in hatchery Atlantic salmon predict metabolic rate and life history?   Kathleen Church, Lida Nguyen-Dang, Bryan Neff, and Christina Semeniuk

Personality, or consistent behavioural differences found among individuals, are often reflective of trade-offs between risk and reward that may also indicate differing life history strategies. Although more active and bold individuals may have increased access to resources, they may also experience greater risk of predation or injury, and thus suffer higher rates of mortality. Consequently, active and bold individuals may exhibit faster life histories, with faster growth and metabolic rates occurring alongside higher mortality. We assessed the predictive power of personality in determining growth and metabolic rate for hatchery raised juvenile Atlantic salmon (Salmo salar) with a series of repeated behavioural trials, followed by an assessment of metabolic rate via respirometry. Firstly, individual fish were tagged using PIT tags, then personality was evaluated using a series of repeated videotaped trials, where the activity, space use, and response to novelty was assessed for each fish. Following four repeated personality tests, fish were then placed in an intermittent flow respirometry chamber for a period of 24 hours to assess metabolic rate. The goal of our study is to use the assessment of personality to increase the effectivity of behavioural screenings for hatchery managers looking to maximize production. (Oral)

Does the complexity and variability of early rearing environment influence responses to novel environmental situations in brook charr (Salvelinus fontinalis)?   Melissa Goodwin and Rob McLaughlin

Captive rearing and stocking can be important conservation tools for the recovery of populations that are declining in nature. However, the success of these tools can be limited if stocked individuals do not survive and contribute to population growth. For fishes, being reared in conventional hatchery conditions can impair the cognitive abilities of individuals and their ability to adapt to novel situations, potentially reducing the probability of survival upon release into the wild. It has been hypothesized that rearing fish under more complex and variable conditions will encourage brain development, improve cognitive abilities and responses to novelty, and increase stocking success. We tested the first two parts of this hypothesis by rearing brook trout (Salvelinus fontinalis) under conditions differing in habitat complexity (no structure, structure) and variability in the location of habitat structure and the timing of feeding (stable, unstable). Fish from 8 families were reared under each of the rearing treatments for 3 months and then tested for risk taking in a novel environment and time to attack a novel prey item. Our initial findings suggest that the responses to novelty for fish reared under the different conditions were more complex than expected and differed among families. (Oral)

Does use of habitat selection phenotypes increase the predictive power of fish habitat models? Emmanuelle Chrétien, Steven J Cooke, and Daniel Boisclair

Telemetry techniques are useful to study moving animals like fish in their natural environment, and tracking data have been widely used to understand individual fish habitat selection. Tracking data also has the potential to reveal distinct fish-habitat associations shared by groups of individuals (e.g. habitat generalists vs specialists), which can be defined as "habitat selection phenotypes" (HSP). While there is growing interest in integrating repeatable individual differences (or animal personality) into habitat models, there can be potential to integrate a mid-level source of variability with HSP (between the individual and population level). In this study, we used a combination of clustering and resource selection functions to develop and validate habitat models based on smallmouth bass Micropterus dolomieu tracking data. First, we computed a cluster analysis to identify shared fish-habitat associations, which resulted in three HSP. Then, we fitted and compared habitat models of increasing complexity that integrated HSP and/or individual variation to tease apart between- and within-group variability. We expect that HSP will comprise a large proportion of individual variability. Our findings could emphasize the need to consider between- and within-group variability to increase model predictive power, and provide a new approach to the development of fish habitat models. (Oral)

Drop-Camera Surveying: An Alternative Method of Data Collection for Improved Resource Management Within Sea Cucumber Fishing Areas.   Danni Harper, N David Bethoney, Kevin DE Stokesbury, Mark Lundy, and Michael JW Stokesbury

Global demand for sea cucumber products has continued to increase regardless of collapses in tropical stocks resulting from over-exploitation. This has opened an economic opportunity for Atlantic Canada where Cucumaria frondosa are plentiful. Sea cucumber fisheries have developed off Eastern Canada for the past decade, but population dynamics remain largely unknown. As stock assessments and fisheries quotas are strongly influenced by these population dynamics, this lack of information could lead to mismanagement and instability within the industry, increasing the risk of over-exploitation. For long-term sustainability, an understanding of these population dynamics is paramount. We have conducted fisheries-independent drop-camera surveys of sea cucumber fishing areas on the Scotian Shelf. With images taken during surveys we identified patchy distributions of sea cucumbers that correspond to substrate distributions with higher abundances found on hard substrates. We also determined that there was low species richness in areas with high densities of sea cucumbers, suggesting lower risk of bycatch. Drop-camera assessment methods provide more ecological information than traditional survey methods and are also only less impactful on the environment. Moving forward, data from fisheries-independent camera surveys can provide some of the information necessary for management to make informed decisions leading the industry toward long-term sustainability. (Oral)

Ecological legacy of DDT archived in lake sediments from eastern Canada.   Josh Kurek, Paul W MacKeigan, Sarah Veinot, Angella Mercer, and Karen A Kidd

Past forest management practices led to widespread aerial application of insecticides, such DDT, to North American forests. Lake basins thus provide an important archive of inputs and aquatic responses to these organochlorines. We use dated sediment cores from study lakes in multiple watersheds in New Brunswick, Canada, to provide a regional perspective on this legacy stressor in remote lake ecosystems. Peak sedimentary levels of p,p'- and o,p'-DDT (total DDT) and breakdown products DDE and DDD occurred during the 1970s to 1980s. Sediments exceeded probable effect levels (PELs) by ~450 times at the most impacted lake. Modern sediments in all study lakes still contained levels of DDTs that exceed PELs. We show that aerial applications of DDT to eastern Canadian forests likely resulted in large shifts to primary and secondary consumers within several lake food webs. Modern pelagic zooplankton and benthic invertebrate communities are now much different compared to those present before DDT use, especially at the most impacted lakes. Our findings suggest that a regional organochlorine legacy may exist in the modern food webs of many remote lakes in watersheds where DDT was applied widely. (Poster)

Ecological thresholds of the Chinese mystery snail (Cipangopaludina chinensis).   Meghan Fraser, Sarah Kingsbury, and Linda Campbell

The Chinese mystery snail, Cipangopaludina chinensis, is a non-indigenous, potentially invasive aquatic species found throughout North America. To better understand the potential spread of C. chinensis in Nova Scotia, the ecological thresholds of the species need to be established. The salinity tolerance [(0, 5, 10, 15, and 20) ppt], and pH tolerance (pH 4, 5, 6, 7) were tested in the laboratory for two to four weeks using adult and juvenile C. chinensis. The migration patterns of C. chinensis were monitored bi-weekly at three HRM lakes. Migration monitoring was done in spring and summer, noting the depths at which the snails are living when water levels and temperatures change. C. chinensis did not survive in salinity concentrations 10 ppt or higher, but did survive in 0 ppt and 5 ppt. This suggests C. chinensis could inhabit brackish water with low salinity. The snail migration surveys show the snails are typically found in shallow water when the temperature is warm (20°C and above), and in deeper water when the temperature is cool (20°C and below). This research suggests the ecological tolerances of C. chinensis may allow for the species to spread into vulnerable ecosystems not previously considered as a suitable habitat. (Oral)

Effects of acidification treatment on personality-dependent spatial ecology of migrating Atlantic salmon smolts.   Omar S Taboun, Edmund A Halfyard, and Christina AD Semeniuk

Freshwater acidification contributed to the decline of Atlantic salmon (Salmo salar) populations in eastern Canada. Acidification affects osmoregulation by disrupting the sodium-potassium pump, compromising ion regulation. This physiological stress may modify central neural processing, altering predator response and

exploratory behaviours which are crucial during smoltification when juveniles migrate through novel habitats. These behaviours may impact migration success by influencing residency time and subsequent mortality. Conservation efforts include liming, which neutralizes freshwaters through the direct addition of calcium carbonate. Here we examine the effects of lime treatment on personality traits of wild Atlantic salmon smolts and investigate subsequent migration movement and survival to determine whether acidification impacts predator avoidance, spatial exploration and migration success. We conducted stream-side behaviour trials on migrating smolt originating from rivers with different acidification treatments (nlimed water=99; nnon-treated water=17 smolts) in Sheet Harbour, Nova Scotia, and implanted coded acoustic transmitters in a subset (nlimed water=54; nnon-treated water=17) before release. We will analyze trials for responses to: food stimuli, simulated predation and shelter; and determine if these behaviours predict migratory "reversal" movements, habitat-dependent residency time, and survival using telemetry data. These findings allow us to assess whether liming is an effective restoration method for Atlantic salmon migratory behaviours. (Poster)

Effects of wave exposure on the population dynamics of the invasive bryozoan Membranipora membranacea in the Eastern Shore Islands, Nova Scotia.   Claire Attridge, Anna Metaxas, and Danielle Denley

On the southwestern shore of Nova Scotia, Canada, encrustation by the invasive bryozoan Membranipora membranacea has caused defoliation of canopy forming kelps. We investigated the effect of exposure to wave action on the population dynamics of M. membranacea in the Eastern Shore Islands (ESI) of Nova Scotia, Canada, a proposed marine protected area where kelp beds remain intact. We examined canopy cover and density of dominant kelps (Laminaria digitata, Saccharina latissima, Agarum clathratum) at each of 6 sites in the region which span a range of wave exposures in July, August, and October 2019 using video transects and quadrat sampling at 6 and 9 m depths. Additionally, we measured density of settlers of M. membranacea on artificial collectors, and settler density and percent cover of adult colonies on kelp blades. All sites exhibited seasonal patterns of settler abundance on artificial collectors consistent with previous studies from the southwestern shore of Nova Scotia, Canada, with significant differences among sites irrespective of levels of exposure. As climate change continues to influence the region through warming waters and increased frequency of large-scale storm events, understanding the dynamics of invasive species and the associated impacts on kelp resilience are imperative for effective conservation planning. (Oral)

Emergent insects as contaminant biovectors at historical gold mine sites.   Molly LeBlanc, Michael Parsons, Emily Chapman, Gavin Kennedy, and Linda Campbell

Emergent (hatching) insects can act as biovectors of contaminants from aquatic environments. Here we examine the transport of mercury (Hg) and arsenic (As) via emergent insects from contaminated wetlands, which have been impacted by historical gold mine tailings. Gold mining has been an important part of Nova Scotia's social and economic history since the mid-1800s and there are currently 64 gold districts spread across the mainland. Although many are long-abandoned, a legacy of environmental contamination remains at most sites. The ecological effects of historical tailings on Nova Scotia's aquatic environments remain largely unquantified. The results of this study show that insects can bioaccumulate significant levels of Hg and As while in their aquatic, larval life stage when they are in direct contact with the water, sediment and/or soil. Aquatic invertebrates from tailings sites had elevated [Hg] (up to 4.20 ppm) and invertebrate [As] frequently exceeded CCME guidelines for fish. We also present results on the biotransport of Hg and As in hatched, adult life stages at five legacy gold mine wetland sites and two reference sites. Adult emergent insects were shown to be likely biovectors of Hg, while As was largely shed with casings during hatching. (Oral)

Environmentally associated chromosomal structural variation influences fine-scale population structure of Atlantic salmon (Salmo salar).   K Beth Watson, Paul Bentzen, Sarah Lehnert, Tony Kess, Steven Duffy, Brian Dempson, Sigbjørn Lien, Matthew Kent, and Ian R. Bradbury

Chromosomal rearrangements have long been associated with environmental variation. Atlantic salmon exhibit variation in chromosomal rearrangements across the species natural range, yet the role and importance of these structural variants in maintaining adaptive differences and structuring wild populations remains poorly understood. Here, using a 220K SNP array, we genotype Atlantic salmon from 26 populations

within a highly genetically structured region of southern Newfoundland exhibiting evidence of trans-Atlantic secondary contact to characterize structural variation and identify environmental associations with structural variants. Multivariate analysis using two discrete years of samples suggests a translocation between chromosomes Ssa01 and Ssa23 is the dominant factor influencing population structure in the region. Redundancy analysis indicates regional population structure is most strongly correlated with temperature and precipitation, with environmentally associated loci clustering in the translocated region. Furthermore, tests for selection provide evidence of positive selection acting on both the translocated and non-translocated homokaryotypes. Our analysis suggests environmentally mediated selection acting on standing genetic variation in genomic architecture introduced through secondary contact may underpin fine-scale local adaptation highlighting the importance of introgression and chromosomal structural variation as drivers of contemporary adaptive divergence. (Oral)

Estimating benthic population abundances using trap fisheries data.   Eric Pedersen, Darrell Mullowney, and Krista Baker

Accurately estimating the abundance of benthic populations is vital for both fisheries management and for understanding the ecology of a species. One of the most popular methods of estimating heavily fished populations is to use a depletion estimator, which relies on how quickly catch per unit effort declines with fishing effort to infer how large the population was when fishing started. Depletion estimators depend on the assumption that the fishing gear has the same catchability at all population sizes. However, many benthic species, like Snow Crab or American Lobster, are fished with traps which can saturate at high population densities. This can result in substantially over-estimating population sizes, and overestimating both rates of population decline and increase. We have developed a new Bayesian model that allows simultaneously estimating trap saturation, gear catchability, and initial population size in spatially structured populations. We illustrate how this model can be used to improve estimates of rapid declines in Snow Crab across a large-scale metapopulation on the Newfoundland Shelf. (Oral)

Evolutionary and demographic history of introduced brook trout in national park alpine lakes. Brent Brookes, Hyung-Bae Jeon, Alison Derry, and Dylan J Fraser

Due to high colonization potential, introduced invasive aquatic species can stymie conservation efforts. However, the underlying contributions of standing and adaptive genetic variation to successful colonization of these populations are not well understood. Previous works have shown that an increase in the number of individuals stocked, and number of stocking attempts can result in greater neutral genetic variation, and that environment differences (i.e. habitat size) can elicit selective pressures on introduced populations, potentially supporting greater adaptive genetic variation. In this study, we use whole-genome sequences of sex-differentiated pooled populations (pool-seq) to determine the extent to which neutral and adaptive polymorphisms influence colonization success. Nine populations of introduced Brook trout (Salvelinus fontinalis), in Banff, Kootenay, and Yoho national parks in Alberta and British Columbia, Canada, were examined with respect to how their stocking histories and differences in their environments might influence standing and adaptive genetic variation. This work contributes to understanding how underlying genetic factors in neutral and adaptive polymorphisms and between sex affect colonization success of introduced species. (Oral)

Experimental harvesting of a socio-economically important fish species to reveal utility of eDNA to monitor abundance in harvested fisheries populations.   Matthew Yates, Dylan Glaser, Melania Cristescu, Dylan Fraser, and Alison Derry

Previous research has demonstrated consistent correlations between aquatic species-specific eDNA particle concentration and density/biomass. However, no research has experimentally manipulated population abundance in nature and monitored corresponding changes in eDNA concentration. Such efforts are crucial to determine the utility of eDNA to monitor natural populations experiencing declines due to activities such as human harvesting. Brook trout are an invasive species in the Rocky Mountains and remediation efforts by Parks Canada routinely target such populations for removal. In collaboration with Parks Canada we will conduct whole-lake harvest experiments based on controlled depletions of nine brook trout populations over three years. The census size of each population will be quantified annually and five populations will then be subjected to a simulated size-selective harvesting regime; eDNA samples will be collected every year from each lake pre- and post-harvest to evaluate brook trout eDNA particle concentration. Preliminary results

are promising; eDNA particle concentration exhibited a positive correlation with brook trout density (R2 = 0.66) and biomass (R2 = 0.71) in the 2018 pre-harvest samples. The opportunities to conduct such tests in an empirically controlled manner are rare; this experiment therefore represents a valuable opportunity to empirically evaluate the efficacy of eDNA as a non-invasive fisheries monitoring tool. (Oral)

Exploring fish microbial communities; opening the fish microbial black box.   Javad Sadeghi, Subba Rao Chaganti, and Daniel D Heath

Recent studies revealed that the gut microbial community (MC) plays a key role in nutrition, immunity, and even in brain function and behavior – key factors for the viability of the individual, population and the species. The fish gut MC is under-studied compared to other vertebrates, yet fish are a group that emerged over 600 million years ago, and include about 28,000 known extant species. Hence this study is aimed to characterize the effects of environment and host species on individual fish MC composition. A total of 332 fish belonging to 19 species were collected from Lake Ontario, Lake Erie, and Detroit River. Gut MC was evaluated using metabarcode sequencing of 16S rRNA gene (V5-V6). Canonical coordinate analysis was used to test the effect of specific environmental factors (T, pH, TP, and TN) and the surrounding aquatic MCs on the composition of MCs associated with the gut fauna of fish. PERMANOVA analysis was used to test for difference in MC structure within and between sites. Mann-Whitney U-test and Kruskal-Wallis test was used for comparisons of microbiome among fish, within species, with different phenotypic variables (gender, age, size). Overall, the results will be discussed as to whether environmental stressors, habitat microbial community, or fish species' physiology play critical role in defining the fish gut MC. (Oral)

Exploring salinization trends and drivers in prairie aquatic ecosystems.   Matthew Bogard, Kerri Finlay, Heather Haig, Sarah Ellen Johnston, and Peter Leavitt

Global increases in salt content, alkalinity, pH, and conductance in lakes, rivers, and coastal environments are a developing problem with unclear implications for the management and protection of aquatic ecosystems. For the Canadian Prairies and arid landscapes worldwide, climate-induced changes in ionic strength are often complex, dependent on local geology, hydrology, and land use. This complexity limits our current understanding (and therefore management capacity) of aquatic ecosystem responses to salinization and associated changes in ionic strength and composition. Our study aims to quantify the trajectories of change in ionic strength and composition in prairie lake ecosystems, and define how these changes relate to hydroclimatic and local (land-use and soil) characteristics. (Oral)

Extreme life-history variation in non-anadromous Atlantic salmon: adaptation or constraint? Jeffrey Hutchings

Salmo salar exhibits variability in life history, habitat, and migration matched by few vertebrates. Ouananiche ('landlocked' Atlantic salmon) are distributed in eastern North America and northern Europe. Habitat ranges from hundreds of metres of river to Europe's largest lakes. Ouananiche exhibit two life-history forms. Those with access to a lake migrate to feed and grow rapidly prior to reproduction. Abundant prey (smelt, vendace) facilitate large sizes at maturity (50 to 85 cm), high fecundity (thousands of eggs), and an ability to persist in high-diversity (more than 20 fish species) environments. In contrast, small-bodied ouananiche (10 to 30 cm at maturity) prey on insects, have low fecundity (as few as 30 eggs), and can only persist in low-diversity environments (fewer than 5 fish species) that lack large predators. The smallest ouananiche are at the species' edge, or boundary, of life-history variation. The production of very few, very large eggs by small-bodied ouananiche can be explained as an adaptive response to low predation mortality in early life coupled with selection for large juvenile size. (Oral)

Fire, ice, and peat: Assessing the impact of forest fire to lakes of the subarctic peatlands. Thomas Pretty and Derek Gray

Increased frequency and severity of wildfire has been well recognized to be a cause of climate change. Wildfire is one of the most impactful disturbances to boreal water catchments where damaged forest vegetation can reduce evapotranspiration, increase snow accumulation, and accelerate snowmelt. These cumulative effects can increase runoff, erosion, organic material, and trace metals into water bodies. However, large variability and limited studies impede our predictions within discontinuous and continuous permafrost locations. In 2014, severe megafires spread throughout Canada's North West Territories, burning a landscape rich in lakes

and ponds. Using a reference condition approach, lakes within the discontinuous peatland Sahtú Settlement Area reveal to have increased benthic invertebrate and macrophyte richness four years after wildfire. Benthic invertebrates have shifted compositional percentage of functional feeding groups and decreased EPT species. Lake dynamics are more reliant on allocthanous input, including the bioaccumulation and biomagnification of toxic methyl-mercury. It is well established that there is a need to understand the dynamics of how wildfire impacts lake ecosystems. Canada's boreal forest is home to 25% of the world's wetlands with millions of lakes, yet boreal forest lakes have been infrequently studied post-fire. (Oral)

Gamefish movement drives homogenization of Ontario freshwater fish communities. Kevin Cazelles, Timothy Bartley, Matthew Guzzo, Marie-Hélène Brice, Andrew MacDougall, Joseph Bennett, Ellen Esch, Taku Kadoya, Jocelyn Kelly, Shin-ichiro Matsuzaki, Karin Nilsson, and Kevin McCann

Globally, lake fish communities are being subjected to a range of scale-dependent anthropogenic pressures, including climate change, eutrophication, overexploitation, and species introductions. As a consequence, the composition of these communities is being reshuffled, in most cases leading to a surge in taxonomic similarity at the regional scale, termed homogenization. The drivers of homogenization remain unclear, which may be a reflection of interactions between various environmental changes. In this study, we investigate two potential drivers of the recent changes in the composition of freshwater fish communities: recreational fishing and climate change. Our results, derived from 524 lakes of Ontario, Canada sampled in two periods (1965–1982 and 2008–2012), demonstrate that the main contributors to homogenization are the dispersal of gamefish species, most of which are large predators. Alternative explanations relating to lake habitat (e.g., area, phosphorus) or variations in climate have limited explanatory power. Our analysis suggests that human-assisted migration is the primary driver of the observed compositional shifts, homogenizing freshwater fish community among Ontario lakes and generating food webs dominated by gamefish species. (Oral)

GEN-FISH: Genomic Network for Fish Identification, Stress and Health. Margaret Docker, Christina Semeniuk, Steve Cooke, Nicholas Mandrak, Bryan Neff, Trevor Pitcher, Oliver Love, Tonhzhe Li, Sara Jamieson, and Daniel D Heath

Freshwater fish resources (commercial, recreational and Indigenous fishing sectors; fish (aqua)culture) contribute to Canada's economy both directly and indirectly. Yet, freshwater fish stocks are under threat. Furthermore, the logistical difficulties of monitoring the status of fish stocks in Canada's 2+ million lakes are compounded by the limitations of conventional sampling methods, which can be harmful to the fish community and their habitat. To address this critical management gap, a Genome Canada funded a project to develop genomic resources to aid in the effective management of Canada's freshwater fish resources. Our project will provide three main deliverables to academics, regulatory agencies, and other stakeholders: 1) Fish Survey Genomics: a standardized environmental DNA (eDNA) toolkit (e.g., protocols, primer "bank") for the detection and quantification of all freshwater fish species in Canada. 2) Fish Stress & Health Genomics: a suite of quantitative gene expression assays ("fish health chip") to assess fish health and environmental coping capacity. 3) Decision-Guiding Tools: identification of translational pathways that would accelerate the informed uptake of genomics-based tools in the fisheries/aquaculture sectors. This presentation outlines the scope and nature of GEN-FISH, a network of over 23 researchers from 13 Universities and over 50 partners across Canada. The ultimate goal is to work with Canadian researchers and freshwater fish stakeholders to help stem the decline in freshwater fish abundance and diversity, initially in Canada and, ultimately, globally. (Oral)

Genetic differentiation among sympatric resident and anadromous Arctic char (Salvelinus alpinus) in Labrador, Canada is largely non-parallel but for a few key genes. SJ Salisbury, GR McCracken, R Perry, D Keefe, T Kess, C Nugent, BF Koop, MM Ferguson, RG Danzmann, and DE Ruzzante

The repeated evolution of sympatric morphs of Arctic char (Salvelinus alpinus) within the Quaternary provides natural replicates of incipient speciation, offering a unique opportunity to study the genomic mechanisms of speciation. Sympatric anadromous and resident Arctic char are frequently observed but their genetic relationship remains unknown. We used an 86K SNP chip to investigate the character and consistency of the genomic differences among sympatric resident and anadromous Arctic char from three lakes in Labrador, Canada. Varying, but strong genetic differentiation among morphs was observed in all lakes.

Parallel divergent selection across lakes was apparent for only a small fraction of outlier loci. These represent good candidates for "speciation genes", fundamental to the manifestation of morphs. Additionally, paralogous copies of the same gene were sometimes observed to differentiate morphs in different lakes. Many of these paralogs occurred on linkage groups resulting from the whole genome duplication of salmonids, suggesting that this event may have facilitated multiple genetic pathways to achieve a common phenotypic divergence. Our results therefore support the importance of both contingency and determinism in the genomic differentiation of resident and anadromous morphs of Arctic char. (Oral)

Habitat mapping in support of sustainable management of benthic resources. Jessica A Sameoto, Craig J Brown, David M Keith, Myriam Lacharité, Brittany Wilson, Vicki Gazzola, Ian Church, Ahmadreza Alleosfour, Alexa J Goodman, and Tony R Walker

Canada has recently re-committed to the integration of an Ecosystem Approach to Fisheries Management (EAFM) and Marine Spatial Planning (MSP) under its oceans management strategy. Although commitments have been made at a policy level, there remains a strong need to develop substantive scientific methods that enable the operationalization of these management approaches. In the Maritimes Region, Canada, a range of post-processing approaches have been used to combine data from acoustic survey techniques such as multibeam echo sounders (MBES) with in-situ sampling from imagery surveys (i.e. stills/video) to generate a range of high resolution (at the scale of meters) thematic map products to meet multiple ocean management needs; thus extracting maximum value from a single investment. This talk will provide an overview of how these maps, produced for German Bank and the Bay of Fundy, combined with geospatial fishery data, have fundamentally improved our understanding of species dynamics, enabled environmentally conditioned advice for fisheries management, delineated sensitive benthic areas, and establish baselines for future ecosystem monitoring. The breadth of uses for these maps demonstrates the significant potential that habitat mapping has in supporting the spatial, and sustainable, management of benthic resources. (Oral)

Habitat quality modeling : A comparison of models based on fish densities from Snorkeling and Video Recording visual sampling. Cynthia Guéveneux-Julien and Daniel Boisclair

Freshwater ecosystems are among the most affected by human activity. Positioned as receivers in addition to being enclaved, rivers and lakes are affected by all activities occurring in their watershed and aquatic species have limited access to replacement habitats. One of many ways to assure the survival of freshwater fish species is to protect key habitats. Habitat quality models (HQM) are used to identify such habitats by describing the relation between a habitat's quality index (e.g. species' density) and the environmental variables prevailing in it. However, the quality of a HQM's recommendations will depend on the quality of the sampled data they are built on. Here, we compared HQM based on fish densities measured by two distinct visual sampling methods : 1) transect by snorkeling and 2) fixed sampling by video recording. Analyses show that, out of 5 species-specific and one community HQM computed, transect method produces slightly better models 4 times out of 6 (mean of 10% more variation explained). However, environmental variables selected by each species' models vary between methods. We conclude that snorkeling transects produce better predictive models for most species sampled yet snorkeling and video recording sampling methods both provide unique information on key habitats' description. (Oral)

Identifying corridors of connectivity using genomic estimates of migration and resistance pathways to inform Marine Protected Area network design in the Northwest Atlantic. Nick Jeffery, Mark Wilcox, Ben Lowen, Claudio DiBacco, Rob Beiko, Ian Bradbury, and Ryan Stanley

The integration of population genomics with fine-scale environmental data and landscape (or 'seascape') barriers to gene flow allows for a better understanding of patterns of fine-scale population structure and the evolutionary processes that shape patterns of marine biodiversity. We used genome-wide single nucleotide polymorphism to estimate contemporary rates of migration and correlate these with potential dispersal corridors based on suitable habitat and oceanographic data in the northwest Atlantic for American lobster, Sea scallop, Atlantic cod, and the invasive European green crab. Habitat suitability models based on presence/absence data and environmental covariates were developed for each species and used to determine potential corridors of connectivity among populations using resistance paths based on circuit-theory. Patterns of gene flow were estimated using FST matrices and estimates of effective migration surfaces using genetic data to directly compare to generated matrices of resistance pathways. Additionally, we combine estimates

of effective migration surfaces with resistance landscapes to create maps of 'functional connectivity' in these four species. Our research contributes to a better understanding of connectivity among populations of species with different life-histories, and can inform spatial planning in the Northwest Atlantic, including the design of Marine Protected Area networks. (Oral)

Identifying habitat associations for fishes in Lake Winnipeg using large scale bathymetric and substrate data linked with fish telemetry data.   Tyana A Rudolfsen, Doug Watkinson, Colin Kovachik, Colin Charles, and Eva C Enders

Habitat suitability indices (HSI) are used to describe fish habitat use and/or quality. HSI can be obtained through (1) professional judgment, (2) habitat use data based on frequency of occurrence of actual habitat conditions used by different species and life stages or (3) habitat preference data that combines the frequency analysis with additional information on the habitat availability in the sampling reaches. Often this data is obtained in focal positions where fish are present and absent, as determined through visual observations (e.g., snorkeling) at one point in time and under limited environmental conditions. Here, we propose the use of acoustic telemetry data will provide more complete and reliable habitat associations. To test our hypothesis we used telemetry collected for > 500 individual fish of four different species (Walleye, Freshwater Drum, Common Carp, and Lake Sturgeon) in Lake Winnipeg over a large receiver network (n > 200). The fish positions will be linked with water depth and substrate obtained from a lake-wide Biosonics MX Visual Habitat echosounder survey and Ponar substrate samples. Our results intend to highlight habitat use during different biologically significant periods such as rearing, spawning, and overwintering. (Oral)

Impact of seiches on assessment of fish species abundance in Lake Erie coastal wetlands.. Nathan Tuck, Joseph P Gathman, Dennis M Higgs, and Jan JH Ciborowski

Fishes are important indicators of the productivity and ecological condition of coastal wetlands. Their distribution in wetlands is controlled by water quality (especially temperature and dissolved oxygen concentration) and local habitat (depth, substrate and local vegetation). The goal of the current research is to determine the extent to which seiches (wind-driven short-term transport of cool, well-oxygenated water) influence the composition and relative abundance of fishes as inferred from fyke net catches. This research analyzes overnight catches of fishes in relation to water level (as affected by seiche), water and air temperature, wind speed and direction and dissolved oxygen concentration. We sampled two Lake Erie coastal wetlands from July to September 2019 with loggers that measured D.O, water temperature, depth and light intensity every 15 minutes over 40 days. Fishes were retrieved daily from 3 nets set/day in the wetland, yielding 4070 individuals, 3346 of which were measured (total length). 65% of seiches had magnitudes between 10-20 cm (26 days), 23% between 5-10 cm (9 days) and 13% between 20-35 cm (5 days). Interpreting results will help researchers understand how weather conditions influence interpretations of local fish movement and guide sampling protocols to account for seiches in Great Lakes fish assessments. (Oral)

Implications of spatiotemporal variation in the distribution of Atlantic cod and Yellowtail flounder for management of time-area closures on Georges Bank.   David Keith, Jessica Sameoto, Christine Ward-Paige, Freya Keyser, and Irene Andrushchenko

Sustainable fisheries management is a central component of Canada's commitment to protect marine ecosystems and spatial management tools such as closures are a commonly used tool to attempt to achieve sustainability goals. The objectives of closures can vary from the protection of stock-specific life history traits utilizing small scale temporary time-area closures, to complex ecosystem-based management goals that include a network of permanently closed areas. Since 2006, on the Canadian side of Georges Bank, relatively small (less than 300 square km) seasonal time-area closures have been implemented to mitigate bycatch from the Canadian offshore scallop fishery of Atlantic cod (Gadus morhua) and yellowtail flounder (Pleuronectes ferruginea) during spawning. Here we use fishery independent surveys from both Canada (DFO) and the United States (NMFS), and a suite of environmental covariates, to develop spatio-temporal species distribution models (ST-SDMs) for these two species on Georges Bank. We evaluate the strengths of these new statistical models to inform the management of protected areas and contrast them against existing methods. Our results indicate that ST-SDMs can be used, in conjunction with fishery dependent data, to provide advice that enables risk-based fishery management decision making. (Oral)

Improvement of Atlantic salmon post-stocking recruitment success and survival by induced

neophobia training.   Istvan Imre, Grant E Brown, William Dew, Roger Greil, Kevin Kapuscinski, Kevin Loftus, and Randall Claramunt

Atlantic salmon (Salmo salar), a once abundant and iconic salmonid species in Lake Ontario, was last reported in 1898 and was designated extirpated in 2006. Sporadic restoration attempts between 1880 and 1980 were not successful. Since 2006, Atlantic salmon have been the subject of a large-scale, persistent re-introduction effort into selected Lake Ontario tributaries by the Ontario Ministry of Natural Resources, the Great Lakes Fishery Commission and collaborating partners. However, the goal of establishing a self-sustaining population of naturalized Atlantic salmon has remained elusive, in part likely due to hatchery selection for maladaptive behavioural phenotypes. This presentation will briefly survey ways in which a successful Atlantic salmon reintroduction program could address these behavioural deficits through 'life skills training'. Considering that predation is the primary cause of post-release mortality in hatchery-reared fish, we suggest that induced neophobia (i.e. fear of novelty) training is perhaps the best way to increase post-stocking survival. Nevertheless, a comprehensive reintroduction research program should evaluate the efficiency of various combinations of life skills training approaches to improve stocking success. (Oral)

Inferences on environmental associations and depth-specific behaviour of Atlantic halibut (Hippoglossus hippoglossus) in the Gulf of St. Lawrence using pop-up satellite archival tags. Marie-Pier Boulanger, Hugues Benoît, Arnault Le Bris, and Dominique Robert

Landings of Atlantic halibut have been increasing since the early 2000s in the Gulf of St. Lawrence (GSL). Even though the status of the stock is considered healthy, knowledge gaps remain in our understanding of its biology, limiting the development of sustainable management strategies. One key knowledge gap concerns habitat associations, in particular those of the largest individuals that are not well captured in multi-species bottom trawl surveys. Moreover, existing habitat association data are mostly limited to summer months, corresponding to the timing of scientific surveys and the fishery. Pop-up satellite archival tags (PSATs) constitute a new technology allowing to track depth and temperature trajectories of individual fish over a full seasonal cycle. Using the data from more than 100 PSATs deployed on GSL halibut between 2013 and 2017, the objectives of this study are to (1) assess seasonal and spatial variability in temperature and depth associations and (2) to identify the temporal scales and origins of depth-specific periodic behaviours based on spectral analyses. Results from this project will contribute to improving the assessment of an important fishery resource in the GSL. (Poster)

Integrated conservation planning for priority watersheds within the NS Southern Upland Priority Areas.   Fielding Montgomery, A Weston, B Rutherford, and Eddie Halfyard

Nova Scotia's Southern Upland contains at least 72 watersheds that provide valuable habitat for several aquatic species. A regional restoration framework is needed to promote the ecological integrity of these aquatic ecosystems, with emphasis on the recovery of four aquatic at-risk species: Atlantic Salmon, Atlantic Whitefish, American Eel and Brook Floater. The goal of this project is to develop a multispecies Watershed Stewardship Plan for candidate priority watersheds to aid in conservation delivery. Eight priority watersheds were selected by experts based on conservation, societal, and science-led evaluation. For each watershed, previously collected biotic and abiotic data will be summarized to identify knowledge gaps and prioritize sites for additional sampling. Tools such as LiDAR-based mapping, remote sensing, water chemistry analysis, and eDNA will be used at select sites, to contribute to our overall understanding of key habitat areas with high recovery potential. We will then integrate species-habitat relationships, important habitat-conservation biology principles, and ecological integrity and threat assessment information in a spatially explicit framework. Ultimately, the assessment output will identify, detail, and rank pragmatic conservation actions across spatial planning units within the eight watersheds to guide conservation planning. (Poster)

Intergenerational transfer of maternal effects via DNA methylation in Chinook salmon.   Clare Venney, Oliver Love, Jane Drown, and Daniel Heath

Maternal effects serve as an important adaptive mechanism to prepare offspring for a predictable environment, though the molecular mechanisms underlying maternal effects remain unclear. DNA methylation has been suggested as a mechanism for the propagation of maternal effects, though the resetting of DNA methylation patterns during fish embryogenesis makes intergenerational transfer of DNA methylation a controversial idea. Here we used a replicated 6x6 factorial breeding design and gene-targeted bisulfite sequencing for

growth, immune/stress, and developmental genes to determine the genetic architecture of DNA methylation during three early developmental stages (eyed egg, alevin, and fry) in Chinook salmon. We found strong evidence for maternal effects on locus-specific and CpG-specific methylation that declined with developmental stage, consistent with conventional evidence for maternal effects in fish. We show that methylation may serve as a molecular mechanism for the intergenerational transfer of maternal effects, with potentially important effects on offspring fitness. (Oral)

Investigating Atlantic tomcod (Microgadus tomcod) dietary habits and coastal migration into spawning habitat within Minas Basin, Nova Scotia. Lindsay A Carroll, Darren Porter, Joseph Beland, Trevor S Avery, Montana F McLean, and Mike JW Stokesbury

The Atlantic tomcod is a gadid fish that lives for an average of three years and occurs along North Atlantic coastlines from Labrador, Canada to Virginia, USA. It is abundant in coastal waters in Nova Scotia and is a valuable resource for many predators. Locally it is known as "frostfish" given that it spawns further inshore during the winter months in estuaries and freshwater streams. It has been fished as a minor commercial and recreational species and have traditionally been used as a winter food source by Mi'kmaq First Nations communities throughout its range. Despite its abundance and widespread distribution, there has been little research on its ecology and movement. In this study we tagged 120 tomcod using acoustic telemetry to investigate seasonal spawning migrations from November – February from adjoining tidal river systems in Minas Basin to potential spawning areas. Also incorporated are biological sampling methods, including the morphological identification of consumed prey, to determine baseline tomcod diets and feeding habits in the area. Results will be used to inform management approaches and strategies for Atlantic tomcod in local regions and to enable better stewardship of this marine fish. (Oral)

Investigating migration patterns of Atlantic herring in light of environmental change: A case study for industry led science contributing to improved understanding of stock structure. Jenna Munden, Rabindra Singh, Art MacIntyre and Derek Knox

The SW Nova Scotia/Bay of Fundy component of the 4VWX Atlantic herring (Clupea harengus) stock, has supported one of the longest running commercial fisheries in Canada and has been a valuable economic driver in coastal communities of New Brunswick and Nova Scotia for centuries. Despite being a well studied stock with a history of tagging studies, significant warming and ecosystem changes have occurred in the Gulf of Maine ecoregion in recent years which may have effected SW Nova Scotia/Bay of Fundy herring migration patterns. In 2016, the Herring Science Council initiated a tagging program to investigate pre-spawn migration patterns of herring in light of environmental change. During the four-year program, an average of 13,000 t-bar tags were applied annually from commercial purse seiners on herring feeding and spawning grounds during the fishing season. Although the original purpose of the project was to better understand migration patterns of pre-spawn fish, it has generated significant information on stock structure, providing evidence that contradicts current held assumptions used for management. This project is a success story in terms of industry-led science initiatives leading to useful information to improve fisheries management, and lessons learned will be presented along with preliminary results. (Oral)

Lake sediments help recognize the historical presence of a nuisance alga on Vancouver Island, British Columbia. Alex Di Lonardo and Joshua Kurek

Didymosphenia geminata (Didymo) is a freshwater benthic alga which occurs as nuisance blooms in nutrient poor streams and rivers. Because Didymo blooms impact the riverbed environment and community structure with thick mats of biomass, concerns have increased about the impact to fish, especially juvenile salmon in some watersheds. Bloom-prone areas often lack long-term monitoring data, thus the historical presence and environmental drivers of Didymo blooms are poorly understood. To tackle this, our study addresses the following questions: Are the reported algal blooms in the upstream watershed a novel phenomenon? And what are the drivers associated with past blooms? To answers these, our study uses lake sediment cores as natural archives of past environmental conditions. The study site, Cameron Lake, British Columbia, has reported Didymo blooms in its watershed since 1991. The research will use X-Ray Fluorescence (XRF) to identify watershed changes as well as observations of Didymo to identify presence through time. Preliminary results recognized that Didymo was historically present in low abundances with proliferation in abundances occurring only recently. This result indicates that blooms are likely a novel phenomenon and suggests the

watershed is undergoing a period of change to conditions favoring blooms. (Poster)

Landscape controls of water quality indicators to inform management of agricultural reservoirs. Kerri Finlay, Sydney Emmons, Jackie R Webb, Matthew Bogard, and Heather A Haig

In the semi-arid, highly agricultural region of the northern Great Plains, lakes and reservoirs often experience poor water quality for recreation and agriculture. Nutrient and salt concentrations in these reservoirs are impacted by factors that can be managed for, such as underlying soil characteristics and land-use, and those that cannot, such as water balance (evaporation to inflow ratios; E:I). Here, we sought to identify management opportunities for improved water quality by evaluating hydrological estimates of E:I and GIS estimates of drainage basin soil characteristics and land-use to determine the relative influence of landscape-scale factors on salinity, conductivity, and TN, TP and SO_4^{2-} concentrations in 101 agricultural reservoirs (dugouts) over three years, across a ~240,000 km2 prairie region. Overall, higher E:I ratios and drier years were correlated with higher concentrations of all solutes in these reservoirs. Land-use and soil characteristics were not strongly correlated with reservoir solute concentrations, but deeper reservoirs exhibited lower N and P concentrations. Together, these data suggest that management for reduced nutrient concentrations may need to focus on basin morphology, but farmers need to be more alert to water quality issues in drier years, and more work is needed to identify controls of salts in these agricultural reservoirs. (Oral)

Light-hearted lobsters: using a novel methodology with free-ranging heart rate biologgers to assess the effect of light pollution on stress in Spiny Lobster (Panulirus argus). S. Clay Steell, Erika Eliason, and Steven Cooke

Light pollution is a growing threat to aquatic species and ecosystems globally, and has been found to cause physiological stress in myriad terrestrial animals and in some aquatic vertebrates. Little work has investigated its effects in aquatic invertebrates, however, despite their abundance, ecological significance, and importance to fisheries. This study investigated the effect of unnatural light at night in Spiny Lobster, a major fishery species in the western Atlantic Ocean. We used a novel method of surgically implanting heart rate biologgers paired with externally fixed accelerometers to assess how unnatural light at night affects stress and behavior in free-ranging Spiny Lobsters in a shallow water mesocosm. The results of this study inform whether light pollution has sub-lethal effects on this important fishery species, and whether light pollution from rapidly urbanizing coastal areas around the world pose a threat to marine invertebrates and their ecosystem function. This study also elaborates a compelling new method in studying the physiology of wild or free-ranging decapod crustaceans, which could have wide applications in research and management of important fisheries species. (Oral)

Long-term monitoring protocol for American Eel (Anguilla rostrata) based on high performance computing simulations of sampling effort. Judith Bjorndahl, Lydia Stevens, Danielle Quinn, and Trevor Avery

American eel were oversampled in a capture-mark-recapture study in a small protected watershed in Nova Scotia as part of a long-term monitoring program. Population size estimates were calculated using the Schnabel method, where sequential samples were each referred to as a 'capture event.' A sensitivity analysis was performed to determine how population estimation accuracy is affected by the number of traps set out, trap fishing time, frequency of capture events, number of traps checked per capture event, and seasonality of sampling. Simulations were performed by subsetting catch data collected over four years. Randomly selected traps and varied capture event intervals were used to simulate various monitoring efforts. Each combination of parameters was simulated 100 times using high performance computing resources to obtain a large dataset. The resulting population estimates were evaluated for accuracy and reliability in comparison to the population estimates calculated using all available data to determine the minimum sampling effort required to obtain equivalent-to-baseline population estimates. In three of the four years of the study, estimates asymptotically reached the baseline estimates as number of traps increased. Based on these simulations, we suggest a sampling protocol and analysis framework that optimizes efficiency. (Oral)

Managing uncertainty and reproducibility in cryptic skate classification. Danielle Quinn, Paul Snelgrove, and Trevor Avery

The inability to differentiate accurately and confidently among morphologically similar species that overlap spatially (cryptic species) constrains effective conservation and management strategies. Cryptic Winter

Skate (Leucoraja ocellata) and Little Skate (L. erinacea) populations in the Bay of Fundy, Nova Scotia, Canada illustrate this challenge and provide a real world case study. Historical and current approaches to handling this doubt include removing data with high perceived uncertainty or pooling data to consider these species as a single complex. However, the success of these methods is questionable and the implications to species conservation are likely severe. Machine learning offers a promising alternative by detecting otherwise "hidden" patterns without the need for explicit indication of pattern location. By applying supervised machine learning, we generated predictions of species classification with equal or higher accuracy than alternative methods. Beyond simple measures of accuracy, the development of an online interactive user interface which utilizes these routines in real time demonstrates the relative importance of reproducibility and accessibility in managing uncertainty effectively. We will present a case study of the strengths, limitations, and potential application of accessible, implementable machine learning routines for retroactive and on-the-ground differentiation of Winter and Little Skate, explaining its broader application for a wide range of classification challenges. (Oral)

Marine ecosystem surveys in the Pangnirtung region explore community-based fisheries options and characterize species-habitat distributions.   Jonathan Fisher, Wade Hiscock, Chris Dawe, and Susan Fudge

In Arctic marine waters, observed increases in accessibility to marine resources due to decreasing sea ice and expected large-scale redistribution of fisheries catch potential in response to forecasted future warming suggest the potential for increasing fisheries opportunities. Building upon the extensive Nunavut Coastal Resources Inventory for the Pangnirtung region, we developed a collaborative 10 day survey program aboard an inshore research vessel using whelk/shrimp pots, plankton sampling gear, and baited remote underwater video with the goals of: (1) consulting with Pangnirtung residents to identify priority survey areas and target species; (2) identifying potential resources for community-based fisheries, and expand the knowledge of species distributions and northern range limits for fishes and invertebrates by identifying the biomass of catch, including (but not necessarily limited to): Greenland halibut (Reinhardtius hippoglossoides), whelk, and shrimp, and; (3) collecting underwater video footage at the sea floor and near the surface in order to gain additional insight into marine species distributions and abundance, and bottom habitat characteristics. All three objectives were achieved in August 2019, yielding estimates of the distribution of shrimp, whelk, kelp, and Greenland sharks in the Cumberland Sound region. (Poster)

Maximum metabolic rate is underestimated when using a manual chase protocol in salmonids. Graham Raby, Claire Doherty, Ali Mokdad, Trevor Pitcher, and Aaron Fisk

Fish biologists commonly make estimates of maximum metabolic rate (MMR) in fishes using respirometry, and often using those data to generate models of aerobic metabolic scope. Aerobic scope models are frequently used to make projections about how species will fare under climate warming scenarios, or to better understand basic aspects of thermal niche. However, many researchers estimate MMR in their fish by manually exhausting them with a chase protocol (and sometimes air exposure) followed by rapid transfer to a static respirometer for measurement of oxygen consumption rate (and estimation of MMR). Meanwhile, swim tunnel respirometers allow fish to swim maximally and ram ventilate while MMR is measured, a method considered the 'gold standard' for estimating MMR. There are very few published data directly comparing the two methods. In this study, we estimated MMR in Atlantic salmon and Chinook salmon across a 6C temperature range, using both a chase protocol (with static respirometry) and a swim tunnel respirometer. We show that salmon, which are ram ventilators, are not able to achieve true MMR in a static respirometry chamber. Collectively, our data provide useful context for interpreting studies that rely on static respirometry to estimate MMR in ram ventilators. (Poster)

Measuring scientific impact beyond citation count, a fisheries case study.   R. McLaughlin, S Crawford, and A Hellmuth

The impact of scientific publications is typically evaluated by the quantity of citations they receive, yet this metric fails to distinguish if a citation is used to provide background, to extend our understanding, or to recognize the work outside of academia. We are investigating more thorough ways of evaluating the contributions of a publication using the 2007 paper Research to guide the use of barriers, traps and fishways to control sea lamprey as a case study. This publication identified 13 research needs to encourage scientists

from various disciplines to propose basic and applied research to the Great Lakes Fisheries Commission's Sea Lamprey Research Program (SLRP). For this talk, we will test the prediction that within the SLRP, the paper will have been cited more often at the pre-proposal (1) and proposal (2) stages, to establish the relevance of the proposed research, and will be cited less often and as background information at the completion report (3) and publication (4) stages, as the investigators alter their focus to communicating to a broader audience. Our investigation will provide a comprehensive evaluation of the scientific impact of this case study and demonstrate more broadly how scientific impact can be assessed beyond citation counts. (Oral)

Modelling Northwest Atlantic demersal fish and benthic invertebrate assemblages in support of marine protected area network planning.   Ryan Stanley, John O'Brien, Nick Jeffery, Susan Heaslip, and Claudio DiBacco

Marine classification schemes based on physical surrogates often inform marine conservation planning in lieu of detailed biological data, but may poorly represent ecologically relevant biological patterns required for effective MPA network design. We used a community ecological modelling approach to identify and delineate unique mesoscale (10s to 1000s km) assemblages of groundfish and benthic invertebrates in four regions spanning the Canadian Northwest Atlantic. Hierarchical clustering of species occurrence data from annual multispecies trawl surveys revealed 3-6 geographically coherent groupings in each region. We used random forest modelling to identify environmental covariates with assemblage distributions. Spatial distributions of assemblages in each region were largely associated with gradients in minimum annual bottom temperature and large geomorphic features (e.g., troughs, banks, slope breaks). Using regional forecasts for the Scotian Shelf, we demonstrate spatial variation in the influence of climate change on ecological assemblage, with projected changes in the spatial extent and distribution for both shallow and deep water communities most pronounced on the Eastern Scotian Shelf. Biological classifications such as ours can inform the design of ecologically coherent MPA networks by ensuring representative communities are captured in the design and by highlighting areas that may be sensitive to climate change. (Oral)

Moving beyond single-SNP approaches for understanding the genetic basis of Atlantic salmon age-at-maturity.   Marion Sinclair-Waters, Nicola J Barson, Sigbjørn Lien, Torfinn Nome, Jing Wang, Kjetil Hindar, and Craig R Primmer

Understanding genetic architecture is essential for determining how trait variation is maintained under processes such as selection, genetic drift and/or gene flow. In Atlantic salmon, variation in age-at-maturity is thought to be maintained by balancing selection acting on a single large-effect locus. However, it is less resolved how the genetic background, beyond this large-effect locus, may be associated with variation in age-at-maturity. Here, we refine our understanding of the genetic architecture for age at maturity in Atlantic salmon using full-genome sequence data for 313 individuals and 220k SNP array data for 1,518 individuals from over 50 populations. To identify associations between genotype and age at maturity, we use single-SNP and haplotype association tests, and Bayesian variable selection regression tests for multi-SNP associations. We find that a single SNP explains the majority of variation in age-at-maturity associated with a 500k base pair region surrounding vgll3, a candidate gene of large effect. Tests for multi-SNP associations reveal additional small-effect loci that should allow for fine-tuning of age-at-maturity across populations with different selective regimes. Furthermore, this mix of small- and large-effect loci will have implications on how we model and predict responses to selection, such as fishing pressure, in wild Atlantic salmon populations. (Oral)

Non-native chain pickerel and smallmouth bass integration and impacts in Maritimes freshwater food webs.   Linda M Campbell, Jason LeBlanc, Allen Curry, Andrew Lowles, Kellie White, Donald Killorn, and Ree Brennin Houston

Chain pickerel (Esox niger) and smallmouth bass (Micropterus dolomieu) were introduced to a few Nova Scotia lakes in the 1940's for recreational fishing. Since then, the number of waterbodies throughout the Maritimes Provinces with those species have increased significantly, including those containing COSEWIC-listed vulnerable species. Chain pickerel and smallmouth bass are prolific predators which can impact native species and food web structures in a short time. While anecdotal information and stomach content analyses have indicated that native species (e.g., amphibians, small fish, large invertebrates) are rapidly declining in

impacted watersheds, there has been no quantitative food web analyses to date to support those observations. Stable isotopes of nitrogen (d15N) and carbon (d13C) are a long-established tool to quantitatively assess food web connections and model dietary shifts within lakes. Mercury analyses provide information on food web connectivity since mercury consistently biomagnifies in food chains. We sampled fish and invertebrates from over 15 lakes across Nova Scotia plus a lake in New Brunswick. In addition, we have collected unpublished datasets for several lakes. Two lakes in this dataset, Lake Utopia NB and Blackett Lake NS, have been sampled at least twice, providing an opportunity to include temporal comparisons in addition to spatial comparisons. Our stable isotope data confirm that chain pickerel and smallmouth bass are integrated into food webs. This is cause for concern for several Species at Risk, including yellow lampmussel (Lampsilis cariosa), small-bodied Lake Utopia rainbow smelt (Osmerus mordax), as well as cyprinid communities, white perch (Morone americana) and brook trout (Salvelinus fontinalis). Furthermore, there are implications for contaminant transfer in food webs which may impact mercury advisories for the public. (Oral)

Novel approaches to strengthening assessments of data-poor fisheries and conservation-dependent species.   Kayla Hamelin, Megan Bailey, and Jeff Hutchings

Stakeholders, such as fishers, can participate meaningfully in fisheries management through the contribution of local ecological knowledge (LEK) to the scientific assessment of fisheries. LEK can supplement conventional scientific knowledge to ensure that data reflect a holistic ecosystem approach and are responsive to environmental conditions. My research aims to use novel approaches involving LEK to improve fisheries assessments in Atlantic Canada. For example, Atlantic mackerel is a valuable bait fish and supports a widespread recreational fishery, but there are concerns from managers that the stock has been greatly reduced in recent years, in contrast to observations from fishers. Atlantic halibut supports a high-value commercial fishery, but limited data are available about the behaviour and population structure of adult fish. In contrast, although the ecology of Atlantic salmon is relatively well-studied, assessments are based on relatively few index rivers and thus there remains uncertainty about the extent to which mortality from various threats affect salmon. My research will use quantitative survey methods and citizen science data collection to address knowledge gaps for these species. Incorporation of these novel data into fisheries assessments will yield scientific evidence that better reflects, and is more responsive to, current (and changing) environmental conditions. (Poster)

Nutrient composition of Mayfly excretion across streams that vary in dissolved organic carbon (DOC). Marina Taskovic, Sandra Klemet-N'Guessan, and Marguerite A Xenopoulos

Dissolved organic carbon (DOC) is increasing in freshwaters around the world due to global climate change and anthropogenic pressures. DOC quantity and quality can affect physical-chemical properties of streams and subsequently alter aquatic food webs and their functions. We assessed the role of a benthic macroinvertebrate (order: Ephemeroptera) in nutrient cycling across a stream-gradient of ambient DOC concentrations to better test the role of changing DOC on an important ecological function: animal-mediated nutrient cycling. We sampled mayflies in 10 streams that varied in their ambient nutrient and DOC concentrations and measured their release rates of DOC, nitrogen (ammonia; NH4) and phosphorus (soluble reactive phosphorus), as well as their stoichiometric (C:N:P) release rates. Preliminary results indicate that there is a relationship between increasing ambient DOC and the excreted concentration of nitrogen (NH4) and DOC. This suggests that ambient DOC may have a bottom-up effect on consumers in freshwater ecosystems by altering the environment. Overall, this study demonstrates that aquatic macroinvertebrates are important drivers of nutrient cycling. (Oral)

Nutritional co-limitation of Daphnia by phosphorus and calcium revealed through experimental nutrigenomics.   Catriona LC Jones, Aaron BA Shafer, Clay Prater, William Kim, Nicole D Wagner, and Paul C Frost

Lakes across Canada's Precambrian Shield and northern Europe are exhibiting declining concentrations of calcium (Ca) and phosphorus (P). While this may create nutrient-stress on some aquatic organisms, our ability to detect and quantify nutrient-stress on zooplankton by these two elements remains limited. Here, we use next generation RNA sequencing and differential gene expression analysis to examine the molecular phenotypes produced by single and combined limitation of these two key nutrients in the freshwater zooplankter, Daphnia pulex. Our results reveal an intermediate phenotype in Ca- and P-stressed animals,

which provides evidence that D. pulex experiences nutritional co-limitation by both nutrients. We used transcriptome data to identify the most highly up- and down-regulated metabolic pathways, which are presumably involved in mitigating the physiological effects of poor P- and Ca-nutrition. These data are a first step in unravelling complex multi-nutrient interactions in nature and in understanding the effects of multiple limiting nutrients on zooplankton populations. We show that nutrigenomics has the potential to address many of the inherent complexities in studying interactions between multiple nutritional stressors. To realize this potential, more work is needed to lay the genomic groundwork necessary to carry out this type of analysis especially on ecologically significant, non-model organisms. (Oral)

Paleolimnological assessment of eutrophication of southwest Nova Scotian lakes in relation to the local fur farming industry.   Nell LIbera, Joshua Kurek, and John Smol

Recent cyanobacterial blooms in southwest Nova Scotian lakes have prompted concerns from local residents and environmental organizations that these blooms may be linked to mink fur farms in the area. The high volumes of phosphorus-rich wastes produced by this industry remained largely unregulated until 2013, despite a 400% increase in pelt production since the 1980s. Ten years of monitoring data indicate hypereutrophic conditions in headwater lakes with fur farms in their catchment, and eutrophic conditions in downstream lakes. Here, we use sediment records from strategically-selected lakes to reconstruct the relative contribution of multiple stressors to limnological change. This extends the limited monitoring window back in time to pre-date the establishment of the region's mink farms. We assessed changes in sedimentary diatoms, chrysophytes and spectrally-inferred chlorophyll-a to compare the trophic states of lakes with and without mink farms in their catchments. Our preliminary results show differences in the environmental trajectories of these lakes over the past ~150 years. Compared to our reference lakes, diatom records from lakes with mink farms in their catchments show marked compositional changes over the past few decades that reflect eutrophication trends, providing potential evidence that fur farming has impacted water quality for decades. These records provide important insights for watershed management and help to determine restoration targets. (Oral)

Patterns of gene flow, morphological variation, and environmental associations in southern Newfoundland Atlantic Salmon (Salmo salar).   Ben Perriman, Beth Watson, Steven Duffy, Brendan Wringe, Paul Bentzen, and Ian Bradbury

The interaction between selection and gene flow is central to the formation of discrete populations, as selection against migrants can serve as a barrier to gene flow, or continuous migration may prevent or limit local adaptation. Atlantic salmon (Salmo salar) are generally characterized by discrete locally adapted populations at the scale of individual rivers, but the relative importance of natural selection and gene flow from nearby rivers remain poorly understood. The objective of this study is to explore this association between gene flow, phenotype (i.e., morphological variation), and the environment in salmon populations distributed across southern Newfoundland. Specifically, we examine morphological variation using geometric morphometrics, and genetic differentiation using 77 sequenced microsatellites genotyped in 2043 juvenile salmon caught from across southern Newfoundland (2016-2017). Migration rate estimates and genetic distance were used as predicted variables in a Bayesian multiple regression with river watershed characteristics, juvenile salmon morphology, and geographic distance between rivers as predictors. The results suggest that climate and morphology had a significant effect on genetic distance and gene flow. This work highlights the potential importance of selection and local adaptation in characterizing patterns of gene flow among wild Atlantic salmon populations. (Oral)

Permafrost thaw-mediated lake browning.   Kristen Coleman, Josh Thienpont, and Jennifer Korosi

Aquatic ecosystems at the southern limit of permafrost are highly sensitive to climate warming through dramatic alterations of the landscape resulting from permafrost degradation. In the southern Northwest Territories (NT), permafrost is typically restricted to forested peat plateaus that are elevated above the surrounding wetland complex. As mean annual air temperatures approach 0°C, permafrost thaw results in a shift from forested plateaus to wetlands. These landscape alterations can impact aquatic ecosystems through changes in hydrological connectivity and increases in the export of highly coloured dissolved organic carbon (DOC), which contributes to lake browning and affects important aquatic ecological processes. My research will use paleolimnology, which uses chemical, biological, and physical proxy data preserved in lake sediment cores, to track aquatic ecosystem response to thawing permafrost, including changes in DOC concentrations.

Sediment cores retrieved from lakes within the well-studied Scotty Creek basin, and lakes from a latitudinal transect representing different stages of permafrost thaw, will be analysed to investigate spatial and temporal trends in permafrost thaw-mediated lake browning. This research will contribute important advancements in our understanding of how permafrost thaw can impact water quality and aquatic ecosystem functioning, and provide insights into future changes as the permafrost boundary moves northward. (Poster)

Physiological and behavioural consequences of ice angling in freshwater fishes. Caleb Hasler, Jamie Card, John Bieber, Cory Suski, and Mike Louison

Ice angling is a population recreational activity in Canada and the northern United States. Just like during the summer months, fish are exhaustively exercised and then exposed to air for various lengths of time. Additionally, some anglers will keep fish on ice for prolonged periods of time before releasing unwanted fish. Over the past several years, we have explored ice angling as a source for sublethal physiological and behavioural changes. As with angling events during warmer time periods, fish undergo a cellular stress response, tissue damage occurs, and behavioural impairment has been observed. Our work, however, suggest that there are several key differences with respect to the magnitude of negative changes observed, and there is potential for tissue damage from freezing. Overall, it is likely that with proper angling techniques and handling, released fish survive ice angling events. (Oral)

Physiological and behavioural effects of catch-and-release angling on freshwater drum across seasons. Jamie Card and Caleb Hasler

Catch-and-release angling events involve an array of stressors such as air exposure and exhaustive exercise that illicit a physiological stress response, and depending on a variety of factors, delayed mortality is a possible outcome. There have been ample studies in this area, however, significant gaps exist in the literature for species that are targeted by more specialized anglers, such as freshwater drum (FD; Aplodinotus grunniens). We quantified, across seasons, biological responses in FD following angling. FD were angled using standard practices during both spring and summer to assess seasonal variation. Fight time and air exposure were varied to create both a short ($<$ 30-second fight time, $<$ 1-minute air exposure) and long ($>$ 30-second fight time, $>$ 1-minute air exposure) catch-and-release angling treatment to represent different angler skill levels. Location and severity of injury were determined, blood biopsies were taken to quantify stress physiology characteristics (plasma cortisol, glucose, lactate, and intracellular pH), and reflex impairment was assessed. Our findings will support the development of specific guidelines for how anglers can reduce the stress of angling and promote high post-release survival, ultimately ensuring healthy FD populations. (Oral)

Plankton communities in Lake Ontario coastal wetlands are structured by water quality conditions along an urban-agricultural land-use gradient. Eric Anderson and Andrea Kirkwood

Wetlands are vital ecosystems, not only for their role as wildlife habitat, but also their ecosystem services. Human land-use, such as agriculture and urbanization, can negatively impact water quality in the Great Lakes basin. Coastal wetlands are particularly vulnerable because they are typically located at the confluence of tributaries and the nearshore zone. Our study assessed the impact of land-use type and intensity on water quality and the lower aquatic food web (phytoplankton, zooplankton, macrophytes) across a gradient of urban to agricultural land-use in coastal wetlands on the north-shore of Lake Ontario. Four coastal wetlands (Frenchman's Bay, Lynde Marsh, McLaughlin Bay, and Bowmanville Marsh) were sampled along a transect from inflow to outflow May-September 2018-2019. We found a negative relationship between conductivity and species richness for phytoplankton (r = -0.27, P $<$ 0.05) and zooplankton (r = -0.24, p $<$ 0.05) communities. Phytoplankton abundance, measured as chlorophyll a, was positively associated with the water quality variables total phosphorus and total nitrogen (p $<$ 0.05). Overall, results from this study provide important information about the biological condition of coastal wetlands in Lake Ontario, and how continued land-use development and intensification may further impact plankton community composition and structure. (Oral)

Population Genetics Analyses of Yukon Arctic Grayling. Samuel Prystupa, Gregory McCracken, Robert Perry, and Daniel E Ruzzante

In the Yukon recreational and subsistence fishing are important for cultural activities and economic development. Current information is, however, insufficient for the implementation of robust management and

conservation policy. This study aims to estimate the effective (Ne) and census (Nc) population size of Arctic grayling inhabiting the Lubbock system in the southern Yukon, and Blackstone system in northern Yukon. We genotyped 1279 individuals collected from Lubbock and Blackstone systems at n=39 species specific microsatellite DNA markers. Collections from the Lubbock system consisted of 658 Mature individuals and 484 Young-of-the-year (YOY), collections from the Blackstone system were all YOY(N=137). We report on population structure and effective sizes and describe progress towards estimating population abundance in the Lubbock river using the Close kin mark recapture method. Population structure analysis found that within the 8 study sites corresponding to a creek or river, there were 6 distinct populations indicating no evidence of population structure as grouped sites were directly connected. Most populations were found to have Ne that corresponds to high genetic diversity. CKMR analysis estimated a Nc of 2407 for the Lubbock system. This method will be used to inform management and conservation policy in the Yukon for native fish species. (Poster)

Predation of Atlantic salmon smolts migrating out of the Stewiacke River, NS. Daniela Notte, Glenn T Crossin, and David Hardie

The downstream migration undertaken by smolts is a major mortality bottleneck in the life cycle of Atlantic salmon. In addition to physiological and behavioural challenges, smolts in Eastern Canada face increased predation pressures due to the expansion of native predator ranges and the introduction of novel predatory species to natal rivers. These issues are highlighted in the Stewiacke river system (Nova Scotia) where striped bass numbers have increased and chain pickerel have been introduced. The migration progress of 52 Inner Bay of Fundy Atlantic salmon smolts was tracked from May-July 2019 over 92 km from the Pembroke River, NS to the Minas Basin using predation tags and an array of 24 acoustic receivers. Less than half of the tagged smolts survived to the estuary and at least 32% of mortalities were the result of predation. Body condition was not significantly different between smolts that survived to the estuary compared to predated smolts. Future work will focus on linking gene expression profiles from non-lethal gill clips taken at the time of tagging to migration fate to determine if a common intrinsic factor correlates to predation susceptibility. (Poster)

Prioritizing spatial fisheries management using machine learning on diverse information sources to identify habitat function and conservation threats. Jacob W Brownscombe, Lucas P Griffin, Danielle Morley, Alejandro Acosta, John Hunt, Susan K Lowerre-Barbieri, Glenn T Crossin, Sara J Iverson, Ross Boucek, Aaron J. Adams, Steven J.Cooke, and Andy J Danylchuk

To effectively implement spatial management plans it is essential to understand the interplay between essential fish habitat and anthropogenic stressors. In many cases our knowledge of these dynamics is incomplete and may be available in diverse forms such as scientific studies or local ecological knowledge. I will discuss our research identifying potential spawning locations for a cryptic but highly economically valuable fish species, the permit (Trachinotus falcatus) in coastal South Florida using supervised and unsupervised machine learning algorithms applied to diverse information sources including tracking data, stable isotopes, and local ecological knowledge. Pairing this information with knowledge of fisheries trends and anthropogenic stressors, we identify priority management measures that may improve fisheries sustainability now and in future climate scenarios. (Oral)

Quantifying pigmentation and biological characteristics of Anguilla rostrata using image analysis software over migration period. Bailey H Silver, Rod G Bradford, and Michael JW Stokesbury

This study uses image j photo analysis software to quantify the development of elver pigmentation using pixel intensity. Glass eels and elvers are the first stage of the American eel, Anguilla rostrata, life history in which development can be accurately documented. Understanding the development of elvers is especially important as they are being recruited into the elver fishery and this information is essential to manage the fishery properly. Image analysis allows pigmentation to be assessed on a continuous scale and removes human error which may be associated with the traditional visual assessment of pigmentation. Elvers were captured using Irish style elver boxes and scanned with an Epson digital scanner using the thumbnail 3200dpi 24-bit color setting. Multiple areas of elvers were analysed to determine the best locations to show the development from one stage to the next. Analysis of pixel intensity was used to show the development of pigment over the migration period. Other biological traits such as the presence or absence of food items in the gut,

development of the brachial arches, kidney pigmentation, total length, and weight were also recorded. The development of these biological traits were compared to the development of pigment. (Poster)

Quantifying the relative effects of environmental conditions and kelp bed characteristics on the population dynamics of an invasive epiphytic bryozoan on a regional scale.   Conrad Pratt, Anna Metaxas, and Danielle Denley

Non-indigenous species are one of the main threats to biodiversity in the world's oceans, and their impacts are intensifying as a result of climate change. Membranipora membranacea, an invasive epiphytic bryozoan, has been causing damage to ecologically important kelp beds in the northwest Atlantic since its introduction to the area in the 1980s. Although temperature is considered the main determinant of the abundance of M. membranacea, wave exposure and kelp substrate characteristics (abundance and species composition) may also play significant roles. Most previous research has been conducted at a small number of sites within a limited geographic range, and no study has investigated the relative impacts of these variables on bryozoan abundance. By compiling existing data and collecting data from previously unsurveyed sites, we investigate the relative impacts of temperature, wave exposure, and kelp bed characteristics on regional patterns in the abundance of M. membranacea in the northwest Atlantic. This knowledge will facilitate the conservation of kelp bed ecosystems by informing marine spatial planning, and will also be applicable to management in the kelp aquaculture industry. (Oral)

Range-wide genetic assignment reveals long-distance migration in Atlantic salmon.   IR Bradbury, SJ Lehnert, A Messmer, S Duffy, E Verspoor, T Kess, J Gilbey, V Wennevik, M Robertson, G Chaput, T Sheehan, P Bentzen, JB Dempson, and D Reddin

Atlantic salmon (Salmo salar) populations throughout the North Atlantic have declined in recent decades largely resulting from reduced survival during the marine phase, yet our understanding of marine distribution remains limited. Here, we assigned archived individual samples (n=3511) collected throughout the North Atlantic over a half century (1968-2018) to region of origin using range-wide genetic assignment. Unexpectedly assignments revealed the importance of long-distance migration, with European individuals widespread in the west Atlantic from southern Newfoundland to Greenland, and several North American populations detected around the Faroe Islands. Our analysis highlights the widespread importance of the Labrador Sea and Faroe Islands, the prevalence of long distance trans-Atlantic migration (>4000 km) for many Atlantic salmon populations. This study further suggests that environmental conditions experienced by many declining Atlantic salmon populations integrate over much of the North Atlantic Ocean. As such, recent trends in marine survival and population decline likely reflect basin-wide changes in productivity and ecosystem structure and not localized regional changes, emphasizing the vulnerability of the entire species to changing ocean conditions. (Oral)

Reconstructing long-term ecological change in two highly degraded Lake Ontario (Canada) coastal wetlands.   Grace N Hoskin and Jennifer B Korosi

Coastal wetlands are integral to ecosystem health of the Laurentian Great Lakes watershed. Multiple anthropogenic stressors have been impacting coastal wetlands since European settlement in ~1850, and remain a fundamental concern for wetland health as watershed development intensifies. This research explores the use of paleolimnological techniques to understand temporal ecosystem dynamics in two highly degraded coastal wetlands in southern Ontario (Cootes Paradise, Hamilton; Jordan Harbour, Lincoln), using Cladocera subfossil remains preserved in the sediments as paleoecological indicators. In Cootes Paradise, cladoceran assemblage changes observed in the late 1800s are likely tracking the disappearance of aquatic macrophytes, corresponding to the introduction of invasive carp. Despite efforts to exclude carp from the wetland, very little ecological recovery was evident in the Cladocera. Jordan Harbour exhibited a decrease in Chydorus brevilabris and Alona guttata in ~1900, suggesting a loss of littoral habitat similar to Cootes Paradise Marsh; however, ecological recovery was evident after ~2008, when littoral cladocerans increased in relative abundance, coinciding with efforts to remediate shorelines. Overall, this study shows that paleolimnological methods are useful for documenting long-term ecological change in coastal wetlands, extending recent monitoring records further back in time to provide a historical context for ongoing remediation efforts. (Oral)

Recovery dynamics of industrially damaged lake ecosystems (Sudbury) in response to change at multiple scales.   John Gunn, Brie Edwards, and Tom Johnston

This 40 year study (involving multiple collaborators) of the recovery dynamics of lake ecosystems near the massive metal smelters in Sudbury, once the largest global source of sulphur air pollution, provides a unique perspective on the interaction of factors affecting ecosystem change operating at multiple scales: watershed, regional and global. This overview will focus on changes in water quality, zooplankton and fish communities during a period when air pollution was reduced by >97% and will highlight the often surprising role of reforestation, invasive species and brownification of lakes in a warming world. (Oral)

Reducing mercury concentration in Northern Pike in a small Subarctic lake using intensive fishing.   Heather Dixon, Jacob Whitehouse, Mike Low, George Low, and Heidi Swanson

Sanguez Lake is a small Subarctic lake in the Dehcho region of the Northwest Territories, which has traditionally been fished by Jean Marie River First Nation. However, high levels of mercury (Hg) in the Northern Pike (Esox lucius) population from this lake have led to concerns regarding the use of this species as a subsistence food source. In an effort to mitigate the level of Hg in Northern Pike, intensive fishing was implemented, where large (>500 mm) fish were removed from the lake to reduce competition and promote faster growth, resulting in dilution of Hg in the remaining fish. Sanguez Lake was originally sampled in August 2013, with intensive fishing occurring in September 2016, 2017 and 2019, as well as in May 2018 and 2019. To determine the effectiveness and extent of stimulating growth-dilution in this species, Hg concentrations in Northern Pike tissue were compared between sampling periods and seasons. Significantly higher Hg concentrations were measured in 2013 compared with during intensive fishing, while significant variation in slope coefficients of relationships between Hg and fork length, age and length distributions, and age were noted. Significant differences in Hg concentrations between seasons was linked to variation in fish condition and behaviour. (Oral)

Rehatching the redfish-Calanus ecological interaction in the Gulf of St. Lawrence: the reliance of larval redfish on Calanus eggs.   Corinne Burns, Félix Lauzon, Guillaume Veillet, Stéphane Plourde, Pascal Sirois, and Dominique Robert

The massive return of Gulf of St. Lawrence redfish (Sebastes mentella) following multiple successful recruitment events within the last decade suggests that environmental conditions have become more conducive for survival of this groundfish during its larval stage. Starvation and suboptimal growth caused by temporal "mis-matches" with preferred prey and poor nutrition are primary agents of larval fish mortality. A previous study that assessed early life dynamics of one redfish cohort in the GSL suggested the existence of a strong trophic link between larval redfish and spawning output of the copepod Calanus finmarchicus. We tested this hypothesis through the assessment of diet composition and feeding preferences during early redfish development over 4 consecutive years (1997-2000). Larvae consumed large numbers of copepod eggs, primarily from C. finmarchicus, which contributed the largest percentage of carbon to the diet in all years. The continuation of rapidly-warming temperatures in the GSL are predicted to further change the reproductive phenology and abundance of C. finmarchicus in the region. Knowledge of larval redfish growth and survival dependence on the temporal overlap with reproductive events of C. finmarchicus constitutes an important research avenue to improve our capacity to forecast redfish population dynamics. (Oral)

Restoration of Atlantic salmon in a crowded world: effects of interspecific and intercohort competition.   Jim Grant, Emilie Housego, and Laura Weir

In response to the decline and extirpation of Atlantic salmon populations around the world, active restoration programs are underway. In such a restoration scenario, one might think that any surviving or stocked fish would experience low-density environments and density-independent population dynamics. However, these assumptions may be incorrect because stocked or emerging young-of-the-year (YOY) salmon may have to compete with larger conspecifics or exotic salmonids in the watershed. We conducted a meta-analysis to compare the effects of exotic salmonids, primarily brown and rainbow trout, and older conspecifics on the behaviour, habitat use, individual growth rate, and mortality rate of YOY Atlantic salmon. All traits for YOY salmon were negatively affected by competitors, the magnitude of which was roughly similar for equal sized exotics and larger conspecifics. Curiously, the negative effects of exotic salmonids were largely density independent. Unfortunately, most laboratory studies involving exotic salmonids were conducted at densities

much higher than found in the wild. More field experiments at realistic densities are needed to verify the magnitude of these negative effects. (Oral)

Sand lance (Ammodytes spp) biomass and distribution on the Newfoundland Shelf.   Scott Morrison, Hannah Murphy, Fran Mowbray, and Gail Davoren

Top-down trophic cascades occur when top predators are removed from an ecosystem, which can result in rapid population size increases in prey species due to release from predation pressure. In Atlantic Canada, the abundance of several groundfish species, including Atlantic cod (Gadus morhua), declined rapidly during the mid-late 1980s, resulting in a rapid increase in the biomass of forage fish on the eastern Scotian Shelf. In contrast, on the Newfoundland shelf, the linchpin forage fish capelin (Mallotus villosus) population collapsed in 1991. We investigate changes in biomass and distribution of another key forage fish, sand lance (Ammodytes spp), using a 20-year dataset (1996-2015) collected by Fisheries and Oceans Canada during their annual spring multi-species trawl survey on the Newfoundland Shelf (NAFO Divisions 3LNOPs). The number of trawls with sand lance present varied over the study period, as did the sand lance biomass in trawls, but there were no clear increasing or decreasing trends in biomass or presence/absence. Next steps in our analysis include investigating changes in core distribution location and size as well as composition of sand lance in predator diets. (Oral)

Seasonal dynamics of fish community isotopic niches in natural and constructed fish habitats. Karlinng Roberts, Jonathan Ruppert, and Mark Poesch

Habitat offsets compensate for damages to natural habitat caused by socio-economic development projects with habitat construction or restoration. Offsets can be a valuable conservation tool when implemented properly. However, large uncertainties remain surrounding the ability of constructed or restored habitats to support desired ecosystem functions. To address this uncertainty, comparisons between the isotopic niches from four natural lakes and one constructed lake, a habitat offset, in the oil sands region of Alberta during ice-free and ice-covered seasons were performed. Whether fish community isotope niches vary in size, overlap, trophic level, and reliance on littoral resources between seasons and whether these changes are consistent across the land scape was investigated. Finally, whether a constructed lake displays similar seasonal patterns in fish trophic niche dynamics to the natural lakes was tested. Results from this study will improve our understanding of temporal dynamics of fish isotopic niches, in both natural and constructed boreal lakes. (Oral)

Seasonal migrations and habitat use in the recovered stock of Atlantic halibut in the Gulf of St. Lawrence.   Dominique Robert, Paul Gatti, Christiane Dufresne, Dany Dumont, Pascal Sirois, Jonathan Fisher, and Arnault Le Bris

After decades of low abundance, the Atlantic halibut stock from the Gulf of St. Lawrence (GSL) has rapidly bounced back to support a lucrative fishery. However, the sustainable management of this recovered stock is currently limited by major knowledge gaps relative to its biology and dynamics, such as spawning stock biomass, seasonal migrations, and the location of spawning and nursery grounds. We aimed to address some of these knowledge gaps through a collaborative program involving academic and government researchers, as well as industry from 4 provinces. Using data acquired from pop-up satellite archival tags (PSATs), we estimated the seasonal migrations of large individuals from multiple sectors of the GSL using a geolocation model. Our results indicated strong homing of halibut for their summer feeding ground, as well as winter spawning in all deep channels of the GSL. We aim to further our understanding of migration patterns through ontogeny based on otolith elemental signatures, and locate nursery areas by modeling the winter drift of eggs and larvae in the deep layer of the GSL. Results from this program will contribute to the fine-tuning of a new dedicated survey for the stock, and will facilitate its sustainable management. (Oral)

Seasonal mixing across jurisdictional lines between two populations of a freshwater piscivore. Graham Raby, Jason Robinson, Tom MacDougall, Yingming Zhao, Matthew Faust, Jordan Matley, Christopher Vandergoot, Richard Kraus, Charles Krueger and Aaron Fisk

Understanding fish movement is essential when managing complex, valuable, and multi-jurisdictional fisheries like the one supported by walleye in Lake Erie. The fishery is supported primarily by fish that spawn in the western basin of the lake but that are known to make seasonal eastward migrations. However, fish harvested

in the eastern end of the lake are not counted against the fishery's quota because the population mixture of fish harvested in the eastern basin is unknown. We conducted a six year acoustic telemetry study to address knowledge gaps for fishery managers about the movement dynamics of walleye in Lake Erie. Our study provides a novel analysis of the spatial distribution and timing of walleye movements into Lake Erie's eastern basin and estimates of the total number of west-basin walleye available for harvest there. In doing so, we test the hypothesis that abundant walleye migrating from the west end of the lake produce a 'swamping effect', taking the brunt of the fishing pressure and thereby reducing pressure on walleye populations local to the east basin. This study will provide a model by which acoustic telemetry data can be used to directly inform fishery management for species that migrate among jurisdictional lines. (Oral)

Seasonal patterns in scallop fishery discards of Atlantic cod, haddock, and yellowtail flounder inform risk-based management decisions.   Freya Keyser, Jessica Sameoto, and David Keith

Sustainable fisheries management should account for major sources of fishing mortality. On the Canadian side of Georges Bank, landings and discards of transboundary stocks of Atlantic cod, haddock, and yellowtail flounder are monitored against quotas that limit fishing mortality. However, in addition to landings and discards from the groundfish fishery, there are considerable discards of these stocks from the sea scallop fishery. To account for mortality from both fisheries, quota allocations for each stock are split at the start of the fishing season between the groundfish and scallop fisheries, with allocations adjusted following an in-season review. This review uses within season discard estimates of cod, haddock, and yellowtail flounder to project total end-of-year discards for the scallop fishery; any remaining quota is re-allocated to the groundfish fishery. Here, we evaluate and compare two approaches for projecting end-of-year discards within season; an empirical method based on scallop fishery landings and a seasonal modelling approach. Seasonal trends in discards were identified, with discards of all three groundfish species highest in April or May. The seasonal models out-performed the empirical landings-based projection method and our results demonstrate that accounting for seasonal patterns in discards better informs risk-based fishery management decisions. (Oral)

Seasonal variation in CO2, CH4, and N2O emissions from small farm reservoirs in the northern Great Plains.   Sydney Emmons, Peter R Leavitt, Gavin L Simpson, Helen M Baulch, Jackie R Webb, and Kerri Finlay

There is increasing interest in the role of small ponds in the global carbon budget, but to date, relatively little work has focused on constructed farm ponds (reservoirs). Farm reservoirs differ from natural water bodies in their shape, hydrology, and management, all of which impact spatial and temporal variation in greenhouse gas (GHG) emissions. A spatial survey of emissions from prairie farm reservoirs in 2017 indicated that many are an unexpected sink for GHGs. However, it is unclear to what extent seasonal variability will affect the integrated annual GHG budgets of these reservoirs. To address these issues, we measured concentrations and fluxes of GHG from 20 farm reservoirs in southern Saskatchewan through the ice-free period of 2018. Overall, carbon dioxide (CO_2) concentration decreased from spring to fall, methane (CH_4) concentration was greatest during the warmest months, and nitrous oxide (N_2O) concentration was most elevated immediately after ice melt. The estimated total CO2-eq was ~20 times higher in 2018, compared to estimates from 2017. Current estimates suggest there may be 16 million small constructed water bodies globally, and thus understanding of the regulations of seasonal variability are crucial for the full understanding of small water bodies in the global carbon budget. (Oral)

Shifting zooplankton species composition in St. Pauls Inlet, a brackish lake, reflects wider ecosystem trends.   Christine Campbell and Erin Stevens

St. Pauls Inlet, a large brackish lake within Gros Morne National Park in Newfoundland and Labrador, is a semi-enclosed body of water with a narrow 80-m wide opening to the sea and freshwater input from 24 streams. Overall salinity can range from 5 g/l at the head of the basin to 29 g/l at the mouth. An initial biological survey of St. Pauls Inlet in 1977/78, during Park planning stages, found the dominant members of the zooplankton community to be copepods Acartia, Calanus, Oithona and Temora. Subsequent surveys of 2009/10 and 2019 found Calanus abundance to be much reduced or absent with no clear cause as to why this might be so. However, recent DFO data suggest that Calanus finmarchicus, a large energy-rich copepod, has declined all across the Gulf of St. Lawrence and the wider Northeast Atlantic, with the zooplankton

community shifting towards smaller, warm-water copepods. This shift is coincident with rising surface sea-surface temperatures. Shifting zooplankton abundances in St. Pauls Inlet, even with its reduced exhange with the Gulf, may therefore reflect these wider ecosystem trends. The difficulty of determining causal factors based on successive sampling surveys that are over 30 years apart is discussed. (Poster)

Simple metrics of ecological connectivity for application to the design of marine protected areas.   Arieanna Balbar and Anna Metaxas

Outputs of the many advanced tools used to measure ecological connectivity rarely translate to conservation measures. We use a conservation-driven approach to estimate ecological connectivity patterns along the eastern Atlantic coast of Nova Scotia, Canada, a proposed marine protected area. Although kelp beds are an important feature of this coastline, their spatial distribution is not well sampled. We aim to predict the spatial distribution of kelp along the eastern shore of Nova Scotia and compare simple metrics of ecological connectivity across patches of kelp. We collated presence and absence data for kelp in the study region (492 observations) and identified subpopulations for further connectivity calculations using a random forest model with depth, slope, distance from shore, bottom type, curvature, and bathymetric position index as the environmental predictors. We then used progressive vector plots, from both empirical measurements using an acoustic doppler current profiler, and hindcast data from the finite volume community ocean model to calculate local dispersal patterns of the dominant kelp species, as well as Asterias spp., Cancer irroratus, and Littorina spp. among kelp bed patches. This research will advance methods for the inclusion of ecological connectivity in the design and management of marine protected areas. (Oral)

Sofishticated tracking: improved protocol for acoustic tagging of sensitive Clupeid fishes, and application in investigating postspawning migration of Alewife (Alosa pseudoharengus) in Minas Basin, Bay of Fundy.   Elizabetha Tsitrin, Montana . McLean, . Jamie F Gibson, David C Hardie, and Michael JW Stokesbury

The Minas Basin, Bay of Fundy, is an important potential source for tidal power in Atlantic Canada due to its large tidal amplitudes and fast currents. This area also serves as a migratory corridor for Alewife – a pelagic forage fish whose annual spawning runs support lucrative commercial fisheries in the Maritimes. Acoustic telemetry can enhance our understanding of the spatiotemporal distribution of fish in areas where tidal turbines are present, however, the use of internally implanted transmitters is limited for Clupeid species due to their sensitivity to handling. A new tagging method was developed, in combination with smaller tags to minimize physical injuries and stress. 75 spent Alewife from the Gaspereau River were tagged during the summers of 2019 using high-residency acoustic tags with a two-month life span. Receiver arrays located in the Gaspereau River, Minas Basin, and at the FORCE site were used to track fish movement. Alewife responded well to the tagging procedure, with 91% (n=68) subsequently detected by the receiver arrays. Of those, 31 were detected at the FORCE site, with an average of 1.6(SD 1.1) detection days per individual. Males and females were detected in near equal proportion (52% females, 48% males). These data will provide new insights into the post-spawning migratory patterns of Alewife, and present an opportunity to address ongoing questions regarding the effects of tidal energy development on fish populations. (Oral)

Structural variation and polygenic divergence drive population structure in Atlantic halibut. Tony Kess, Tony Einfeldt, Brendan Wringe, Daniel Ruzzante, Paul Bentzen, Lorraine Hamilton, Cornelia den Heyer, Jonathan Fisher, Dominique Robert, Nancy Shackell, and Ian R Bradbury

Identifying how genetic variation is partitioned within populations is important to sustainable fisheries management. In North American waters, Atlantic halibut (Hippoglossus hippoglossus) provide a valuable fishery with high rates of harvest, but little is known about whether current management paradigms match genetic structure in this species. Improving management of Atlantic halibut with genomic information is crucial to future stock management, as North American Halibut stocks have undergone multiple population collapses in the past century, with varying recoveries. Here, we use restriction-associated DNA (RAD) sequencing and a high quality, chromosome-level draft assembly of the Atlantic Halibut genome to identify 111,429 single nucleotide polymorphism markers mapped to 23 chromosome-sized scaffolds. Using principal component analysis, ancestry proportion estimation, and redundancy analysis with environmental variation, we uncover subtle population structure between the Gulf of St. Lawrence and coastal Atlantic waters, and identify a subset of 1115 SNPs distributed across all scaffolds with FST values exceeding the 99th percentile (> 0.018),

which accurately recover population structure between these regions. In addition to subtle population structure throughout the genome, we also uncover a large genomic region (5.74 megabases) exhibiting elevated differentiation and linkage disequilibrium between individuals, consistent with a large-scale chromosomal rearrangement. Gene ontology of this region uncovered enrichment of multiple developmental processes, suggesting this rearrangement may underlie cryptic life-history variation in Atlantic halibut. Our results here reveal both polygenic and structural variation underpinning cryptic genetic variation in Atlantic halibut, and demonstrate how genomic data can uncover variation significant to management of marine species at multiple scales. (Oral)

Studying redfish stock dynamics in the Gulf of St-Lawrence using otolith microchemistry.
Lola Coussau, Dominique Robert, and Pascal Sirois

The reopening of the Atlantic redfish (Sebastes mentella) fishery in the Gulf of St. Lawrence (GSL) is imminent after 25 years under moratorium following the explosion in abundance of this species. Due to strong recruitment of three consecutive year-classes: 2011, 2012, and 2013, Atlantic redfish biomass currently represents more than 80% of the total fish biomass in the GSL. The catastrophic decline of several commercially-important fish stocks, such as redfish in the 1990s has placed pressure on fisheries scientists to better understand the dynamics, structure, and connectivity of exploited populations. However, monitoring movements of the GSL redfish population is challenging due to barotauma suffered by individuals during catch-and-release sampling. One alternative to this problem is to use otolith elemental fingerprints as a natural tool to track redfish migrations throughout ontogeny. As a first step, the objective is to verify the applicability of using otolith elemental fingerprint as tracers of redfish movements in the GSL. Preliminary results show that there are significant differences between the otolith elemental fingerprints of 5 geographically distinct sectors of the GSL where redfish were sampled. The sector-specific elemental fingerprint remains consistent through time, validating the use of otolith microchemistry in determining redfish migrations. (Poster)

The American Fisheries Society Standard Methods for Sampling North American Freshwater Fishes Project Update.   Scott A Bonar, Norman Mercado-Silva, and Kevin L Pope

The American Fisheries Society (AFS) developed standard methods to sample freshwater fish populations to aid in data comparison and collection, publishing them in 2009 in the book Standard Methods for Sampling North American Freshwater Fishes. This project involved 284 scientists from 107 different organizations across Canada, Mexico and the United States. Because of interest generated from the first edition, the Association of Fish and Wildlife Agencies (AFWA), and AFS are supporting development of a second edition of the book to move AFS closer towards having development of standard sampling methods as an ongoing activity of the society. Goals for the second edition include querying fish management agencies across North America as to areas of improvement, but otherwise retaining methods as similar as possible to preserve standardization; adding additional requested chapters and expanding participants; and revising data averages and developing a process for updating methods in the future. In our query of agencies across the United States and Canada, and purchasers of the first edition 106 responses were obtained (90 state, provincial or federal agencies, 8 university, 7 private/NGO, and 1 other). Of these, 50% were using AFS standards most or all the time; 45% about half the time or sometimes, and 5% never. Standards were working moderately to extremely well for 90% of respondents, but not well at all to slightly well for 10%. Suggestions given to improve AFS standard sampling methods included slight adjustments to specific gear types, conversion methods with older gears, and methods to convince staff about the importance of standardization. Standardization in industry, medicine and science has led to great advances. American Fisheries Society standard freshwater fish sampling methods are a powerful tool for addressing a wide variety of changing objectives. These methods allow improved assessments with larger samples sizes, the ability to design before-after-treatment-control experiments, the ability to conduct robust time-series analyses on data; and the ability to collaborate across political boundaries when managing the continent's fish populations. (Oral)

The Chemical Composition of Zooplankton Mediated Dissolved Organic Matter Cycling.
Sarah Ellen Johnston, Kerri Finlay, Mackenzie Metz, Robert GM Spencer, David E Butman, Robert Striegl, and Matthew J Bogard

Zooplankton feeding and excretion modifies aquatic biogeochemical cycles and supports lower trophic levels. Yet, it is unclear how the composition of zooplankton derived DOM impacts the bulk DOM pool. Using optical techniques and ultrahigh-resolution mass spectrometry (FT-ICR MS), we characterized zooplankton DOM processing in a variety of lakes from sub-tropical to sub-Arctic ecosystems. Zooplankton incubated in lake water had a distinguishable net effect on the bulk DOM pool, both modifying the molecular formulae (MF) composition of the water and causing a small enrichment in protein-like fluorophores. A leachate experiment to collect zooplankton excretory DOM showed extreme chemical diversity and relatively high abundance of aliphatic and peptide-like MF. Many N- and S- rich, reduced MF were not found in the bulk lake DOM, likely rapidly consumed by microbes, and thereby preventing accumulation in the water column. Zooplankton DOM products may ultimately help sustain DOM molecular diversity, while fuelling rapid recycling of N- and S-containing DOM needed for diverse processes including planktonic biomass production, cellular signalling, and micronutrient synthesis. (Poster)

The Impact of Boat Noise on Freshwater Fishes.   Katherine Federoff, Maud Ferrari, Mike Pollock, and Doug Chivers

Noise pollution is rapidly becoming more prevalent on a global scale, yet it is one of the least studied anthropocentric disturbances. Sound has low attenuation in water where it travels five times further than it does in air. Such effects, coupled with the wide spatial and temporal distribution of anthropocentric noise, makes noise pollution a major concern for aquatic species that may lack refuge from this modern-day stressor. There is increasing evidence that boat noise can interfere with fish physiology and behaviour. In this field experiment yellow perch (Perca flavescens) will be be randomly assigned to a treatment of 20 minutes of exposure to either ambient noise only (control) or ambient noise plus boat noise at a specific distance (100, 250 500, or 1000 m) from the boat and with a 40 horse power engine. We will be recording pre and post dissolved oxygen levels in the tube that the fish is placed in, giving us an understanding of their metabolic rate during exposure. Our preliminary experiments showed that fish exposed to boat noise had increased metabolic rate. This study provides more information on the impacts of boat noise on fish in their natural environment, particularly with regard to freshwater lakes where data are very limited. (Oral)

The replicability and reliability of eDNA applications to monitor aquatic biodiversity.   Jori B Harrison and Sean M Rogers

The use of environmental DNA (eDNA) metabarcoding to describe aquatic biodiversity is a rapidly emerging technique. However, the robustness of its' application for both species detection and quantification has not been well characterized. To evaluate eDNA replicability, a controlled winter experiment was conducted using 12 naturalized experimental streams. Brook trout (Salvelinus fontinalis), Rainbow Trout (Oncorhynchus mykiss), and Cutthroat Trout (Oncorhynchus clarkii) were caged in each stream at varying biomasses. Triplicate water samples were collected from the start, middle, and end of each stream and filtered to collect DNA, and DNA was sequenced using one published and two novel DNA primers. Although marker choice affected both species detection and taxon resolution, all species were reliably detected with at least one marker set. DNA quantities showed high levels of variation unrelated to biomass both between and within streams, highlighting the need for development of process-based models when using eDNA application to infer species abundances. To our knowledge, this is the first eDNA experiment under a controlled, replicated design within a semi-natural system and will advance our understanding of this promising ecological application. (Oral)

The return of the Striped Bass in the St. Lawrence River: Habitat utilization and distribution range.   Pascal Sirois

Striped Bass was extirpated from the St. Lawrence River and Estuary by the mid-1960 due to cumulative effects of habitat destruction and overfishing. In 2002, the provincial government started a reintroduction program by stocking larvae and juveniles in the upstream section of the estuarine turbidity maximum (ETM), a typical nursery area for this species. Natural reproduction of the reintroduced population was observed during the last decade. Recent studies suggest differences of distribution range and habitat utilization of the reintroduced population compared to the historical population. We used otolith microchemistry to describe habitat utilization and distribution range of larvae, juvenile and adult Striped Bass of the reintroduced population. During early life stages, we identified three migratory contingents across the estuarine gradient.

At the adult stage, there is an important overlap between Striped Bass from the reintroduced population with those from the population of the southern Gulf of St. Lawrence. These results are fundamental to understand population dynamics of the reintroduced St. Lawrence Striped Bass population and provide valuable information to support the management of this highly prized fish species. (Oral)

The role of submergent and emergent vegetation in mitigating water quality in urban stormwater management ponds.   Alexandra Johnston and Andrea Kirkwood

Stormwater Management Ponds (SMPs) have become increasingly common across urbanizing landscapes, and are considered a best management practice for flood control. These engineered systems are typically and unintentionally colonized by aquatic vegetation. We set out to investigate the role of aquatic vegetation by monitoring 15 SMPs across Oshawa, Ontario during the spring, summer, and fall of 2018 and 2019. We detected sizable differences in nutrients (nitrogen and phosphorus) between inflow and outflow locations. The majority of SMPs were significant sources of phosphorus to nearby receiving waters, whereas most SMPs were sinks for nitrogen. Submergent plant density was found to be inversely related to phosphorus concentrations in out-flowing water samples. The percent cover of emergent plants, however, was not found to have a significant effect on nutrient levels between inlet and outlet locations. Furthermore, 3 of our 15 study ponds underwent maintenance dredging just prior to the start of the study. It was determined that these dredged ponds showed no significant difference in water quality compared to undredged ponds. Overall, it appears that submergent vegetation can play an important role in improving water quality in SMPs, and with proper management, could be more effective than traditional dredging practices. (Oral)

Tracking past inputs from mink farms using lake sediment cores in southwestern Nova Scotia.
Jennifer Kissinger, Braden Gregory, David Eickmeyer, Linda E Kimpe, Josh Kurek, John P Smol, and Jules M Blais

Mink farming is Nova Scotia's second largest agricultural export, contributing over \$54 million to the Nova Scotia economy in 2016. Despite its economic importance to the region, the potential effects of eutrophication from nutrients released from mink farms have caused public concern and a polarized debate. It is therefore vital to determine the putative sources of pollution causing algal blooms in Nova Scotia lakes to assess current management strategies. Here we present a multi-proxy approach in a series of lake sediment cores near mink farms and in relatively unaffected reference sites. We used sterol and stanol biomarkers in conjunction with d15N stable isotope ratios in lake sediment cores dated radiometrically by 137Cs, 226Ra, 210Pb to provide a chemical "fingerprint" of organic input of sediment in lakes adjacent to mink farm facilities. A BACI (before-after-control-impact) design model was applied to assess long-term changes to mink and reference lakes over the previous ~150 years. Preliminary results show elevated sterols (e.g. cholesterol, cholestanol) in mink-affected lakes, rising coeval with d15N and the establishment of mink farms in southwest Nova Scotia. The proposed approach offers insight to sourcing water pollution origin and promises to be applicable to other situations facing similar water quality issues. (Oral)

Trophic ecology of redfish (Sebastes sp.) to optimize resource management in the Gulf of St. Lawrence.   Sarah Brown-Vuillemin, Réjean Tremblay, Pascal Sirois, Denis Chabot, Louis Bernatchez, and Dominique Robert

Over the last decade, the Gulf of St. Lawrence (GSL) has undergone a rapid warming of its surface and bottom waters. This thermal change has resulted in a biomass reduction of commercially important cold-water species, such as the northern shrimp (Pandalus borealis), and the concurrent strong rebound of redfish (Sebastes sp.) to record high levels after 25 years of low abundance. The resurgence of this groundfish could exacerbate the ongoing ecosystem shift within the GSL, but impact of this species on other components of the food web remain largely unknown as knowledge of redfish trophic ecology is still wanting. The objective of this project is to better understand the role and impacts of the exploding redfish stock within the GSL ecosystem based on three specific objectives that rely on complementary methodological approaches: (1) Characterization of the decadal variability of the diet of Sebastes sp. using visual prey identification; (2) Validation of visual identification and advanced prey detection through the use of molecular barcoding; (3) Determination of longer-term diet composition through lipid marker analysis. This study will contribute to improving knowledge of the trophic ecology of a key groundfish species and developing sustainable management strategies for the GSL fisheries ecosystem. (Poster)

Updated Bayesian surplus production modelling of an experimental giant red sea cucumber (Parastichopus californicus) fishery in British Columbia for the Kitasoo/Xai'xais Indigenous Group. Reid Steele and Aaron MacNeil

Although the giant red sea cucumber (Parastichopus californicus) fishery in British Columbia is considered sustainable by DFO, harvesters are concerned that the fishery is unsustainable. In 1997, the Kitasoo/Xai'xais indigenous group set up two experimental fishing areas (EFAs) in order to test the effects of different exploitation rates on sea cucumber populations to determine what rates are sustainable. These EFAs (Tolmie Channel and Laredo Inlet) were divided into 5 sites, which were annually surveyed by dive transects then harvested by 0, 2, 4, 8, or 16% of site's virgin biomass from 1998 to the present. The data was modelled by DFO using Bayesian surplus production models in 2011 but has not been updated despite the fishery changing from annual harvest to 3-year rotational harvest. We present updated modelling results based on the DFO's original modelling framework using all currently available data and assess differences between annual and rotational fishing. Compared to the 2011 DFO results, we find Tolmie Channel less resistant to fishing and Laredo Inlet more resistant. Rotational fishing is shown to be slightly more likely to crash the population due it's greater likelihood to trigger depensatory effects. Based on our results, the current fishery is likely sustainable. (Oral)

Urban wastewater induce shift from suspended to benthic primary production in small eutrophic stream of the Northern Great Plains. Nathanael Bergbusch, Zoraida Quiñones-Rivera, Heather Haig, Nicole Hayes, Gavin Simpson, and Peter Leavitt

Mechanisms affecting eutrophication of stream ecosystems can be difficult to discern due to complex interactions between temperature, discharge, light, and anthropogenic nutrients. While effects of nutrients on phytobenthos are well-studied in boreal streams, less is known about phototropic responses in turbid, nutrient-rich prairie streams where phytoplankton are abundant. Here we contrasted the importance of nitrate-rich (10-15 mg N/L) effluent from a wastewater treatment plant that used biological nutrient removal (BNR) (low ammonium and reduced phosphate) with natural environmental controls (hydrology, temperature, transparency) in regulating algae and cyanobacteria in small streams of the Northern Great Plains. Analysis of biomarker pigments (Chl a, carotenoids) by high-performance liquid chromatography suggested that influx of urban wastewater caused a regime shift from phytoplankton to periphyton. Further, communities changed from cyanobacteria to diatoms and some chlorophytes in both habitats, while altering the seasonal development of phytoplankton assemblages. Comparison among sites suggested that wastewater effects were limited to first-order reaches and that normal patterns of seasonal succession were re-established downstream. Taken together, these patterns suggest that BNR treatment can shift turbid, cyanobacteria-rich streams to boreal-like systems with diatom-rich biofilms principally due to changes in the optical properties of wastewater, rather than nutrient flux. (Oral)

Use of new (High Residency) and traditional (coded) acoustic tagging technology to predict if Atlantic Sturgeon (Acipenser oxyrinchus Mitchill, 1815) will spatially and temporally overlap with a tidal turbine test site in Minas Passage, Nova Scotia.. Jessie Lilly, Brian Sanderson, Montana F Mclean, Trevor S Avery, Michael J Dadswell, and Michael JW Stokesbury

The Fundy Ocean Research Centre for Energy (FORCE) was established to test tidal turbines in Minas Passage, Nova Scotia. Minas Passage connects the Bay of Fundy to Minas Basin. Minas Basin is a summer aggregation site for Atlantic Sturgeon (Acipenser oxyrinchus, Mitchill 1815) from endangered and threatened populations in Canada and the US. Historically Atlantic Sturgeon were a commercially important species with fisheries existing along the east coast of North America. To date only two commercial fisheries, remain in operation. In this study, new High Residency (V9-2x) acoustic tagging technology developed by VEMCO coupled with coded pressure measuring acoustic tags (V16) were used to determine if Atlantic Sturgeon passed through the FORCE. During 2018 and 2019, 77% (n = 41) and 31% (n = 23) of Atlantic Sturgeon tagged in Minas Basin were detected at the FORCE test site, respectively. Tagged Atlantic Sturgeon travelled pelagically through the FORCE test site and Minas Passage at similar depths to those proposed for tidal turbine operation. Given the estimated abundance of the summer feeding aggregation of Atlantic Sturgeon within Minas Basin, our study indicated that at current population estimates at least ~ 2790 unique individuals may overlap with the FORCE test site annually. (Oral)

Using early warning indicators to predict critical transitions in a natural aquatic ecosystem.
Anna Kramer, Joelle Young, and Marguerite A Xenopoulos

Critical transitions or regime shifts are dramatic changes in the state of a system, such as from a turbid algal-dominated to a clear macrophyte-dominated state in lakes, and they can be difficult to predict. Early warning indicators use changes in resilience to give warning of an impending transition. We determined whether limnological variables can be used to detect early warnings of critical transitions in Lake Simcoe using a 30-year long-term dataset. We focused on three major transitions in the lake; 1) from turbid algal dominated to clear water state, 2) a period of rapid increase in invasive species, and 3) increased dissolved organic carbon (DOC). We used the "earlywarnings" statistical package in R to test limnological variables including chlorophyll, total phosphorus, dissolved oxygen, and DOC, and attempted to predict the timing of changes using breakpoint analysis. Preliminary results indicate that several variables can be used to predict transitions in Lake Simcoe. For example, in 2011, the lake began a gradual increase in DOC which coincides with a gradual increase in macrophyte coverage. Alternatively, chlorophyll was not a good indicator of regime shift in the lake. More work is needed to determine how different variables can be used for different transitions. (Poster)

Using Midge Remains to Assess the Impacts of Mink Farming on Hypolimnetic Oxygen in Lakes from Southwestern Nova Scotia.   Julia Campbell, Joshua Kurek, Nell Libera, and John P Smol

The ~80-year-old mink fur industry of Nova Scotia has been one of the top agricultural exports of the province. Recent growth of this industry has prompted debate on perceived water quality declines in regional lakes. Sedimentary remains of chironomids and chaoborids from several impact (Nowlans) and reference (Clearwater) lakes were used as bioindicators of long-term environmental change due to their sensitivity to deepwater dissolved oxygen concentrations [DO] and other limnological measures. Invertebrate remains were recovered from dated lake sediment cores spanning the early-1900s to present. Visible reflectance spectroscopy (VRS) chl-a was also measured from sediments as a proxy of trends in whole-lake primary production. Preliminary results at Nowlans Lake indicate declining [DO] with an increase in chironomid taxa tolerant to low oxygen conditions (e.g. Endochironomus and Glyptotendipes) and an increase in chaoborids relative to chironomids occuring in the ~1980s. These trends are positively correlated with greater VRS chl-a and presumably reflect the growth of the region's mink industry. Preliminary results at our reference site, Clearwater Lake indicate stable [DO] levels with no major shifts in invertebrate bioindicators, further suggesting that changes in impact lakes are likely caused by excess nutrients from mink farms within the catchments. (Oral)

What influences the interannual variability of lake water chemistry in Arctic river delta lakes?
Ryan Scott, Suzanne Tank, Xiaowa Wang, and Roberto Quinlan

Arctic environments are changing rapidly due to climate change with impacts on local ecosystems and large-scale hydrological and geochemical cycles. In the Mackenzie Delta, Northwest Territories, temperature-sensitive ice jam flooding causes inundation of floodplain lakes and sediment deposition that maintains floodplain elevation and controls sediment input to the Beaufort Sea. Spring flooding is the primary source of water to the deltaic lakes, and those that are perched at high elevations may not flood for multiple years and are subject to evaporative water loss and concentration of lake water constituents. Increasing thermokarst activity also has the potential to alter lake water composition. Further, lake productivity is high relative to other Arctic regions, with in-lake processes exerting strong effects on nutrients, ions and certain trace elements. To disentangle these influences we examined water chemistry in lakes spanning a gradient of hydrological connectivity over five years of varying peak flood levels, and compared changes in lake water chemistry to that of the main channel. We found ionic composition of lake water to be strongly linked to spring connection time, with evidence of evaporative losses and/or thermokarst activity detected on a lake-specific basis. Implications for the future stability of Arctic river deltas are discussed. (Oral)

Which physicochemical variables should zooplankton ecologists measure when they visit a lake?   Derek Gray, Mariam Elmarsafy, Jasmina Vucic, Rachel Cohen, Mercedes Huynh, Thomas Pretty, and Matthew Teillet

Over the last century limnology and ecology journals have been filled with correlative and mechanistic studies examining how the physical and chemical environment influences zooplankton communities. Despite the rich

literature on the subject, there is still no clear agreement on the suite of physical and chemical variables that should be measured by zooplankton ecologists when they visit a lake or pond. For this study, we perform a literature review to determine: 1) Which physical and chemical variables are typically measured by ecologists studying zooplankton communities; 2) Which of these variables have been shown to be consistently related to zooplankton abundance and diversity; and 3) What type of statistical analyses are most frequently used to examine associations between environmental variables and zooplankton. Our review suggests idiosyncratic or opportunistic decisions about which variables to measure, but most studies included standard limnological variables such as temperature, pH, conductivity, dissolved oxygen, and depth. Some variables, such as pH, temperature, and depth were consistently associated with zooplankton abundance and richness. Early studies contained few statistical analyses and often relied on visual methods such as examining graphs to identify community-zooplankton relationships. Recent studies have moved to inferential statistical analyses with a focus on multivariate techniques. Based on our review, we have produced a list of variables that we recommend investigators measure whenever they visit a lake or pond. (Poster)

Widespread decreases in northwest Atlantic monkfish (Lophius americanus) size structure.
Julie Charbonneau, David Keith, Aaron MacNeil, and Jeffrey Hutchings

Shifts in size structure have been documented for many commercially exploited marine fish stocks, thought to be attributed to size-selective harvesting practices coupled with changing oceanic conditions. Here, using 55 years of fishery-independent survey data, we apply a linear mixed-effects model to quantify temporal changes in northwest Atlantic monkfish (Lophius americanus) length frequencies. This uniquely positioned stock is flanked by the Canadian-American international boundary, thereby facing considerable differences in extraction and management throughout its range. Widespread decreases were evident in both management areas with average fish attaining less than half (52.4%) of their historic body length, indicating that the large fish once prevalent in the 1970s have become uncommon. Understanding the drivers behind these changes, and the associated consequences for population viability, will be necessary to ensure the long-term sustainability of the stock. Key words: anglerfish, goosefish, size structure, population biology, transboundary fisheries (Oral)

Will zooplankton on the great plains be able to "keep up" with climate- driven salinity change?
Mariam Elmarsafy and Derek Gray

The Great Plains of North America are projected to become more arid as the climate changes over the next century. Ecologist are concerned about the lakes in this region, as a drier climate can lead to increased salinity levels. One group of organisms that might be affected by increased salinity are the zooplankton, aquatic invertebrates that transfer energy from primary producers to macroinvertebrates and fish. Little is known about the ability of zooplankton to respond to increasing salinity levels through adaptation or plasticity. For this study, I used resurrection ecology to examine if zooplankton can respond to increasing salinity levels. I worked with egg banks of Daphnia and Ceriodaphnia species collected from Moon Lake, North Dakota; a lake that has experienced fluctuating salinity levels and for which a history of salinity levels has been reconstructed from diatoms. I hatched eggs deposited during periods of high and low salinities and ran salinity tolerance tests to determine if: 1) organisms could survive a range of salinities; and 2) if there was a difference in salinity tolerance between time periods. Preliminary results indicate that there is low tolerance to elevated salinities (3ppt), which is surprising given that some of these eggs were deposited during periods of high lake salinities (10ppt). In addition, a difference in salinity tolerance between time periods was not found, providing no evidence for evolution. Taken together, this suggests future climate change could have a significant impact on zooplankton communities. (Oral)

Winter eDNA assessment of endangered Redside Dace (Clinostomus elongatus) in the Greater Toronto Area. Ashley Watt, Ryland Corchis-Scott, Colin McFarlane, Trevor E Pitcher, and Chris C Wilson

Most of the research conducted on aquatic species at risk is done so in the spring, summer and fall. This temporal bias in assessment can potentially be detrimental in decision making regarding habitat protection. In this study we used eDNA to characterize the presence/absence of endangered Redside Dace in the Greater Toronto Area during the winter. Our poster will summarize locations where Redside Dace were found, compare this to other times of the year and finally we will highlight the need for more winter related studies

on species at risk. (Poster)