AMERICAN FISHERIES SOCIETY

ONTARIO CHAPTER

ANNUAL GENERAL MEETING

February 25 - 27, 2016
Geneva Park, Orillia, ON

"Celebrating Evidence-Based Decision Making in Ontario and Abroad"

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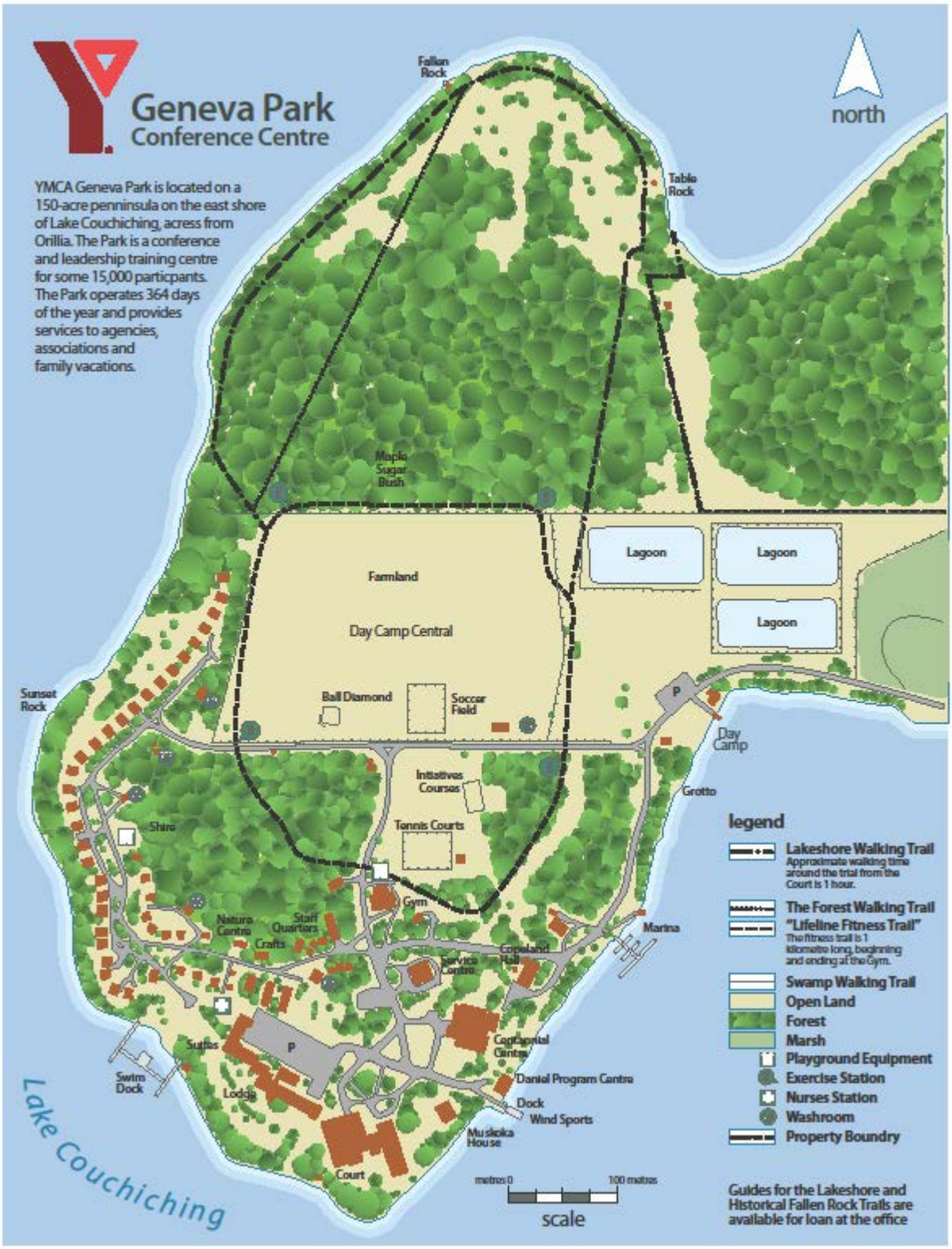
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YMCA Geneva Park is located on a 150-acre penninsula on the east shore of Lake Couchiching, across from Orillia. The Park is a conference and leadership training centre for some 15,000 particpants. The Park operates 364 days of the year and provides services to agencies, associations and family vacations.
north
Fallon Rock
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Ball Diamond
Soccer Field
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Grotto
Initiatives Courses
Tennis Courts
Shire
Gym
Nature Centre
Staff Quarters
Crafts
Service Centre
Copeland Hall
Marina
Suites
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Centennial Centre
Swim Dock
Lodge
Daniel Program Centre
Dock
Wind Sports
Muskoka House
Court
Lake Couchiching
metres 0
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scale
legend
Lakeshore Walking Trail
Approximate walking time around the trial from the Court is 1 hour.
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"Lifeline Fitness Trail"
The fitness trail is 1 kilometre long, beginning and ending at the Gym.
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Marsh
Playground Equipment
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Nurses Station
Washroom
Property Boundry
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"Celebrating Evidence-Based Decision Making in Ontario and Abroad"

Thursday February 25th

5:30-on **Arrival, Registration (Front Desk)**

7:00-10:00 **Opening Mixer (Lodge Lounge Hospitality Suite)**

Friday February 26th

7:30-8:30 **BREAKFAST (Geneva Court)**

08:30 **GREETING AND CONFERENCE OUTLINE (Auditorium)**

08:40 ***Keynote Talk:*** *Governmental fishery policies for Ontario waters since confederation in 1867: Consistent with conservation movements in ecosystemic contexts?* ***Henry Regier***

Session 1

09:20 ***Talk 1:*** *Evidence-based conservation and management of fisheries and aquatic resources in Canada.* **Lisa Donaldson**

09:40 ***Talk 2:*** *Effect of sampling gear and effort on the Index of Biotic Integrity in the Huron-Erie Corridor.* **Meagan Kindree**

10:00 ***Talk 3:*** *Pragmatic decision making for Anthropocene fisheries.* **Kevin Reid**

10:20 **COFFEE, TRADE SHOW, POSTER SESSION (Auditorium and Lobby)**

Session 2

10:30 ***Talk 4:*** *Investigating the effects of population size, divergence, and stress on outbreeding in fragmented populations of Salvelinus fontinalis.* **Zachery Wells**

10:50 ***Talk 5:*** *Investigating the drivers of primary production patterns along the south-east shoreline of Lake Huron.* **Samantha Stefanoff**

11:10 ***Talk 6:*** *Recolonization Trends of Fish Communities Following the Restoration of a Great Lakes Coastal Wetland.* **Natalie Rook**

11:30 ***Talk 7:*** *Use of woody debris in channel restoration.* **Heather Amirault**

11:50 ***Talk 8:*** *The need for more than science – understanding barriers can be as important as having the right evidence.* **Vivian Nguyen**

12:10 **LUNCH (Dining Hall), TRADE SHOW (Lobby) & POSTER SESSION (AUDITORIUM), EQUIPMENT SHOWCASE (Room 8)**

Session 3:

1:00 ***Talk 9:*** *A Summary of Ontario's Early Effort's to Culture at Risk Mussel Species.* **Christopher Wilson**

1:30 ***Talk 10:*** *A summary of Ontario's contributions to a bi-national initiative to restore an extirpated species, Coregonus hoyi, to Lake Ontario.* **Ryan Zheng**

1:50 ***Talk 11****: The synergistic and interactive effects of angler behaviour, gear type, and fish behaviour on hooking depth in passively angled fish.* **Lee Gutowsky**

2:10 ***Talk 12:*** *Developing a novel detection technique for rare freshwater fishes* **Rowshyra Castaneda**

2:30 **COFFEE, TRADE SHOW & POSTER SESSION (Lobby and Auditorium)**

Session 4

2:50 ***Talk 13:*** *An overview of the aquatic ecosystem classification project OMNRF has been developing.* **Nicholas Jones**

3:10 ***Talk 14:*** *Protecting Ontario's Lake Trout: A Case Study of the Intersection between Science and Policy.* **Warren Dunlop**

3:30 ***Talk 15:*** *The influence of groundwater extraction on long-term trends in Brook Trout, Salvelinus fontinalis, population (1996, 1997 -2015) In Monora Creek, Orangeville, Ontario.* **Megan Lloyst**

3:50-4:50 **ANNUAL BUSINESS MEETING (Auditorium)**

4:50-6:30 **TRADE SHOW, POSTER SESSION**

6:30- 7:30 **DINNER (Dining Room)**

7:00-11:00 **MENTORSHIP SESSION AND SOCIAL (GENEVA COURT LOUNGE)**

Saturday February 27th

7:30-8:30 **BREAKFAST (Dining Room)**

Session 5:

08:30 ***Talk 16:*** *Salmon use of a threshold channel.* **Jeff Muirhead**

08:50 ***Talk 17:*** *Misbehaving parents: do smallmouth bass change their swimming behaviours during parental care after an angling event?* **Dirk Algera**

09:10 ***Talk 18:*** *Impacts of climate change on the ecosystem of Sparkling Lake through shifts in lake ice phenology; 1981-2015.* **Bailey Hewitt**

09:30 ***Talk 19:*** *How Ontario's anglers behave: Insights in the digital age.* **Tim Martin***

09:50 ***Talk 20:*** *Consistent individual differences in behaviour of Sea Lamprey: Implications for control via trapping.* **Adrienne McLean**

10:10 **COFFEE & POSTER SESSION (Auditorium and Lobby)**

Session 6:

10:30 ***Talk 21:*** *Ontario's Provincial Fish Strategy: Fish for the future.* **Helen Ball**

10:50 ***Talk 22:*** *The effect of climate change and water level fluctuations on the structure and function of inland boreal freshwater lakes.* **Katrina Gaibisels**

11:10 ***Talk 23:*** *Behaviour of Atlantic salmon released by recreational anglers: Insights from electronic tags.* **Robert Lennox**

11:30 ***Talk 24:*** *The effects of climate change on biotic interactions between walleye and smallmouth bass.* **Lianna Lopez**

11:50 **PRESENTATION OF STUDENT AWARDS AND CONFERENCE WRAP (Auditorium)**

12:15 **LUNCH (Dining Room)**

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"Celebrating Evidence-Based Decision Making in Ontario and Abroad"

Poster Presentation Abstracts

Historical Changes in the Fish Communities of the Credit River Watershed

Brett A. Allen, Nicholas E. Mandrak; University of Toronto Scarborough, brett.allen@mail.utoronto.ca, nicholas.mandrak@utoronto.ca

Patterns of biodiversity loss are prevalent within Canada. Approximately 30% of Canadian freshwater fishes are at risk. Ontario watersheds are of concern due to their diverse fish communities, productive environments, and threats from numerous anthropogenic stressors (Chu et al. 2015). The Credit River watershed, found in southern Ontario, has approximately 60 fish species and faces stressors including climate change, aquatic invasive species (AIS), and urbanization. This research examines fish community change in the Credit River watershed and the multiple stressors responsible for the change. Historical fish datasets collected in the Credit River watershed from 1954 to present will be used to analyze fish community change. Stressor data will consist of historical climate data (temperature, precipitation), population censuses, road density layers, and AIS. The results of this research will provide immediate information on the current state of fish communities in the Credit River watershed. Emphasis will be placed on changes in species richness and the emergence of novel assemblages (homogenization). The results may also be used to better understand the interactive effects of multiple stressors in freshwater ecosystems and provide insight into effective watershed management in areas with diverse fish communities and multiple stressors.

Stream Fish Distribution and Diversity in Algonquin Park

David Benoit, University of Toronto, Harkness Laboratory of Fisheries Research

Freshwater ecosystems are among the most threatened in North America, with extinction rates of freshwater fauna being much higher than their terrestrial counterparts. Proper management and conservation of freshwater diversity relies heavily on estimates of abundance and species richness, both of which depend on effective sampling. Regardless of technique, field sampling rarely leads to the detection of all organsims or species at a given site, ultimately reducing the accuracy of such estimates. This is particularly true for rare and difficult-to-detect species. Recent findings have suggested that multispecies occupancy models can be used to address imperfect detection in community sampling. This is done by using repeated surveys to determine the probability of a site being occupied as well as the probability of detecting an individual at a given site. This allows true absences to be distinguished from false absences associated with imperfect detection. Despite the potential of these models, they have seen limited use in aquatic ecology and their application warrants further research. This study aims to explore the diversity and distribution patterns of stream fish across environmental gradients using multispecies occupancy models to account for imperfect detection. Stream fish abundance and presence-absence data were collected in Costello Creek, Algonquin Provincial Park, in July 2015. A number of environmental attributes were recorded for future consideration. Analysis is underway.

Acoustic telemetry of the reintroduced fish, Walleye (Sander vitreus), in Hamilton Harbour, Lake Ontario.

Jill Brooks; Fish Ecology and Conservation Physiology Lab, Carleton University

Walleye (Sander vitreus), a recreationally and economically important sport fish species, was extirpated from Hamilton Harbour during the mid-20th century. Multiple efforts have been made by Ontario Ministry of Natural Resources and Forestry to reintroduce this valuable species into the Harbour. Hamilton Harbour is a protected embayment (21km^2) in Lake Ontario that was recognised as one of the most degraded bodies of water in the Great Lakes due to decades of pollution, sewage, and habitat loss (IJC, 1999). The Remedial Action Plan (RAP) involves coastal habitat restoration, improved water quality, exclusion of invasive species, and the reintroduction of a top predator, Walleye. OMNRF's recent sampling efforts and local angling groups have already experienced the short-term success of the 2012 stocking attempt, indicating survival and rapid growth rates of the stocked fingerlings. Analysis of acoustic telemetry data will enable us to determine seasonal and hypoxic habitat use, migration patterns, and most importantly for gauging stocking success, Walleye spawning habits. Suitable spawning substrate is largely absent in the harbour, therefore, we will be able to determine if Walleye leave the canal into the main Lake Ontario, and if and when they return post-spawning. Knowledge of Walleye habitat use and spawning activity will provide vital information for guiding future habitat restoration projects, stocking efforts, and will contribute towards the delisting of Hamilton Harbour as an Area of Concern.

Examining how Common Carp respond to Visual and Acoustic Stimuli

Paul Bzonek[1], Jaewoo Kim[2], Nicholas E. Mandrak[1]; [1]University of Toronto Scarborough, [2]Fisheries and Oceans Canada

Major efforts have been undertaken to prevent the introduction and establishment of invasive Asian carps into the Great Lakes. The most likely pathway of Asian carp invasions is through dispersal, which requires passage across geographic bottlenecks such as canals. Non-permanent, behavioral barriers have been proposed as inexpensive means to restrict carp expansion past these bottlenecks while maintaining water flow and anthropogenic transport. However, little research has investigated the behavioral responses of carps to visual and acoustic behavioral barriers, especially in controlled settings. Our research examines the Common Carp (*Cyprinus carpio*) behavioral responses to visual and acoustic stimuli that may be integrated into non-permanent behavioral barriers. Video recorded wetlab trials were used to observe Common Carp movement, activity, shoal cohesion, and spatial occupation within 3x1x0.5m tanks. Common Carp (n=45) were arranged in groups of three to simulate shoaling and were exposed to visual, acoustic and control stimuli to observe behavioral responses. Individuals were identified between and within trials via external tags. Each stimulus trial was composed of a 30 min pre-stimulus, 30 min stimulus, and 30 min post-stimulus period. Visual stimuli were represented by underwater 360^{o} random flashing strobe lights. The acoustic stimulus was constructed using a 50-1500Hz sweep, 50-1500Hz bandsweep, and a high quality recording of a marine engine, all of which were played through a single underwater speaker. This study will provide a detailed examination of how Common Carps respond to stimuli used in proposed visual and acoustic behavioral barriers to movement. These findings may be used to modify behavioral barrier design and inform policy decisions regarding the potential use of behavioral barriers against invasive species, such as Asian carps.

Consequences of littoral zone light pollution on the parental care behaviour of a freshwater teleost fish assessed using tri-axial accelerometer loggers

Jordann Foster; Institute of Environmental Science, Fish Ecology and Conservation Physiology Lab, Carleton University

Ecological light pollution occurs when artificial lights disrupt the natural regimes of individual organisms or their ecosystems. Light has been found to be an important cue for feeding behaviours and predator avoidance in freshwater systems. Increasing development of shoreline habitats leads to increased light pollution (from cottages, docks, vehicular traffic, etc.) which could impact littoral zones of lakes and rivers. Smallmouth bass (*Micropterus dolomieu*) is a species of temperate, freshwater fish from the Centrarchidae family, which are noted for their nest building behaviour; males make depressions in the sand for females to lay their eggs. During the parental care period, male bass guard nests continually, day and night, such that any alterations to their behaviour – either directly because of the response to light or indirectly due to changes in nest predator activity and associated response of the bass – could lead to energy

expenditure for fish that are operating largely on a fixed energy budget. This could have negative fitness consequences. The objective of my thesis is to determine if artificial light pollution alters smallmouth bass nesting behaviour. To address my objective, I tagged nesting bass with tri-axial accelerometer loggers – the same type of sensors that are in contemporary smart phones. I assessed both the effects of low levels of continuous light such as dock lights, and irregular high intensity night lighting such as vehicular traffic on roads adjacent to water bodies, and compared responses relative to appropriate controls. This work will help to address a major knowledge gap in our understanding of the effects of light pollution on fish and will inform the improvement of guidelines related to shoreline development and associated lighting regimes.

Detecting Change in Fish Community Size-Spectra

Abby Diagle; University of Toronto

A novel approach to understanding and monitoring limnic community structure is through the use of size-spectra, a concept designed to represent energy flow through a community regardless of species identity. Size-spectra are constructed by plotting abundance (or biomass) as a function of organism size and log transforming both axes. The result is often a negative linear relationship. Monitoring of both the intercept and the slope (i.e. the spectral parameters) has the potential to indicate when an ecosystem is under stress. However, it is not yet clear if change in the spectral parameters can be detected within a meaningful timescale. To address this issue, a large-scale watershed experiment was conducted at the Experimental Lakes Area (ELA) in northwestern Ontario. The manipulation required turning a fourth-order lake into a headwater lake. Since position in a lake chain is associated with certain lake characteristics (e.g. turbidity, total nitrogen, total phosphorous, etc.), this manipulation is expected to indirectly alter the size structure of the resident fish community. Hydroacoustic data were collected each summer from 2010 to 2015. Fish lengths were calculated from detection data, allowing for the construction of size-spectra. Analysis is ongoing.

Predicting the Potential Asian Carp Spawning in the Tributaries and Nearshore of the Canadian Great Lakes Basin

Tej Heer[1], Nicholas E. Mandrak[1], Zachary Wells[2]; [1]University of Toronto Scarborough, [2]Concordia University

Due to the potential for an Asian carp invasion in the Great Lakes, there is a focus on identifying spawning in tributaries to the Canadian Great Lakes and methods to prevent successful spawning. We will focus on the hydrologic and temperature requirements of spawning to determine whether Asian carp eggs will stay suspended in the water column long enough for the eggs to hatch. FluEgg is a three-dimensional Lagrangian model that recreates the turbulent flow conditions to test if carp eggs will stay suspended and includes a temperature-dependent hatching model to determine when the eggs will hatch (Garcia et al. 2013). Preliminary results will identify a subset of

Lake Ontario and Lake Erie tributaries to the Canadian Great Lakes tributaries that could be suitable for spawning. The identified tributaries adjacent nearshore areas will then be sampled using an Acoustic Doppler current profiler and resulting data used in FluEgg to simulate the fate of the eggs. The results of the model will be used to identify potential spawning tributaries and evaluate possible management actions (e.g. barriers, altered flows) that could be used to prevent successful spawning.

Urbanization, long-term stream flow conditions, and Redside Dace status in Greater Toronto Area streams

Sarah Hogg, Scott Reid; Ontario Ministry of Natural Resources and Forestry

Redside Dace (*Clinostomus elongatus*) is listed as an endangered species under the *Endangered Species Act, 2007*. It is a stream dwelling fish with a strong affinity for slow-moving pool habitat and overhanging riparian vegetation. Loss of habitat arising from urban development activities is considered a primary threat facing the species; although there is some uncertainty regarding the responsible factors. Urban development is known to cause a variety of changes to flowing aquatic ecosystems, including: reduced baseflow, increased frequency of high flow events, and increased variability in flow conditions. The objective of our study was to characterize long-term stream flow conditions at locations with differing Redside Dace conservation status. We used stream flow indices and flow exceedance values to examine stream flow conditions between 1966 and 2013. Significant long-term stream flow alterations consistent with increasing urbanization were observed in locations where Redside Dace populations have been in decline.

Quantifying the resilience of communities to disturbance using a multivariate approach

Karl A. Lamothe[1], Donald A. Jackson[1], Keith M. Somers[2]; [1]University of Toronto, Department of Ecology and Evolutionary Biology; [2]Department of Biology, York University

Since the early 1970s, 'resilience' has become a commonly cited objective for freshwater ecosystem management, yet community-level resilience to disturbance remains difficult to measure. Ideally, community-level resilience could be calculated using data from existing biomonitoring projects. Using simulations we demonstrate a multivariate statistical approach based on common community sampling biomonitoring protocols for evaluating resilience as a function of resistance and recovery. Our simulations were performed in five steps: 1) species distributions were simulated along two artificial environmental gradients; 2) sampling was performed along these gradients to mimic both a Before-After Control-Impact experimental design and a Reference Condition Approach. Resilient reference communities were sampled as communities resisting change and showing natural variability, whereas impacted communities were those responding to disturbance; 3) ordinations were performed with varying ratios of reference to impacted communities; 4) distance-based metrics were calculated from

ordination scores to characterize the relative resilience of communities to disturbance; and, 5) comparisons of distance-based metrics between resilient reference communities and impacted communities were made. For both experimental designs, our results demonstrate that distance-based measures on community ordinations provides a useful technique for characterizing the resilience of communities to disturbances, and highlights the importance of continued biomonitoring programs to inform management decisions.

Occupancy Patterns of Brook Trout in Algonquin Park

Darren Smith, University of Toronto, Harkness Laboratory of Fisheries Research

Modelling species habitat preference can be an effective means for understanding species distributions, identifying key areas for restoration or re-introduction, and for predicting future range shifts with a changing climate. Typically, habitat preference models have been faced with uncertainty regarding imperfect detection, affecting the accuracy of parameter estimates and habitat associations. To help with this problem, recent models of species occupancy have been put forth which account for imperfect detection. Occupancy is defined as the probability of the species of interest being present at a given site, and can be modelled as a function of habitat covariates. Models which best represent the data can be determined using AIC, allowing one to parse out habitat factors which have the greatest influence on occupancy. My work involves the use of data on brook trout occurrence from lakes in Algonquin Park. Triple pass surveys were used in order to generate the necessary data for occupancy models and habitat data was recorded for temperature, dissolved oxygen, time of day, and co-occurring species. Based on the large body of literature using fish to explore the relationship between temperature and habitat suitability, temperature is expected to have the greatest impact on brook trout occupancy. Moreover, occupancy is expected to be highest in the range of temperatures most optimal for growth. Finally, differences between adult and sub adult occupancy will be explored as sub adults may be more likely to occur in warmer waters than their older conspecifics. This might be due to younger fish seeking out warmer temperatures in order to facilitate higher rates of growth and metabolism.

Electric handling gloves provide effective immobilization and do not impede recovery of largemouth bass

Taylor Ward[1], Jacob W. Brownscombe[1], Lee F.G. Gutowsky[1], Robert Ballagh[2], Nick Sakich[3], Derek McLean[4], Geneviève Quesnel[5], Sahil Gambhir[6], Constance O'Connor[1], Steven Cooke[1]; [1]Fish Ecology and Conservation Physiology Lab, Carleton University; [2]McMaster University; [3]University of Guelph; [4]Queen's University; [5]University of Ottawa; [6]York University

Immobilizing fish during handling can reduce the amount of time that the fish is exposed to handling (and often air), and can thereby limit inherent risks from handling

such as physical damage and excessive stress. In professions such as aquaculture, the routine handling of fish requires safe and effective restraint coupled with minimal periods of recovery, necessitating the advent of a rapid means of immobilization and sedation, which has been achieved through the application of electric fields. Low-power constant DC (ranging from 6-30 V, 50-90 mA applied to water generating a voltage gradient of 0.25 – 0.56 V/cm (Keep et al. 2015) is sufficient to induce immobilization in fish but is also safe for human contact. With electric fish-handling gloves (Smith-Root Inc., Vancouver, WA, USA), current is applied to the fish directly from the gloves, allowing the fish to be manipulated out of water. The efficacy of this technology as well as any benefits or negative effects need to be better understood before widespread adoption is to take hold within the fisheries management community. Here, we examine the secondary stress response of largemouth Bass (*Micropterus salmoides*) to handling using electric fish-handling gloves, and evaluate the efficacy of this tool as a means of immobilization. We contrast both the supposed benefits of immobilization (i.e. effectiveness as a restraint) with the potential negative effects of electro-narcosis from electric fish-handling gloves (i.e. potential to cause distress) and measure these against a bare-hand treatment. We evaluate the effectiveness as a restraint by quantifying escape attempts during handling, and evaluate the physiological stress responses using secondary hematologic indicators (blood glucose, lactate, pH and hematocrit).

Juvenile Lake Sturgeon (Acipenser fulvescens Rafinesque) Index Survey, Batchawana Bay, Lake Superior- 2010 – 2015 Catch Data Report

Tyler Noseworthy; Sault College

Populations of Lake Sturgeon (*Acipenser fulvescens Rafinesque*) found within the Great lakes, including the Lake Superior basin, are significantly diminished compared to that of their historical abundances. Due to a decrease in population numbers and a lack of data from historical Lake Sturgeon locations within Lake Superior, an index netting program with standardized sampling methods and protocols aimed towards juvenile Lake Sturgeon (ages 4-15) was implemented. During the years of 2010-2015, this sampling method was used on Batchawana Bay, which is a relatively large embayment located in the southern portion of Lake Superior. Goals of this study were aimed towards looking at Batchawana Bay's juvenile Lake Sturgeon population characteristics (growth and mortality, length classes, population health, age classes) and recruitment patterns (gear selectivity, bay characteristics, gill-net set locations). 126 Lake Sturgeon were caught over the five survey years, 62 of which were classified as juvenile with a mean catch of 1.3 (±SE 0.2) sturgeon/net. A Lincoln-Peterson mark recapture population estimate was used to determine that Batchawana Bay had an approximate population of 1728 Lake Sturgeon, with 432 individuals classified as juvenile. These numbers are relatively low when compared to mean catch numbers from other Lake Superior embayments. A catch curve analysis estimated that the population had an instantaneous mortality rate of 0.038 and subsequently had an annual survival rate of 0.963. When looking at the population characteristics, age classes ranged from <1 to 31 years, with total length classes ranging from 410 – 1440 mm, with an annual growth estimated between 24 – 37.2 mm. Abundance patterns were further analyzed by

sectioning off Batchawana Bay into four quadrants (Inner Bay 1, Inner Bay 2, Outer Bay 1, and Outer Bay 2), and calculating the CPUE for net sets within each Area. It was evident that net location within the bay influenced catch as higher CPUE numbers were observed in Inner Bay 1 yielding a CPUE of 1.45 and Outer Bay 2 a CPUE of 1.40, both ranging 0.25-0.45 sturgeon/net higher than their counterparts. Data gathered within Batchawana Bay during 2010-2015 and knowledge of Lake Sturgeon's relative abundance within the bay and surrounding areas will further enhance future management strategies within the Lake Superior basin.

Effects of Multiple Stressors on Brook Trout Populations in the Greater Toronto Area

Yiminxue Zheng, Nicholas E. Mandrak; University of Toronto Scarborough

Brook Trout (*Salvelinus fontinalis*) has been in decline in the Greater Toronto Area (GTA) since the 1800s due to multiple stressors. As a coldwater species, it is particularly sensitive to rising water temperatures due to land-use change and climate change. To assess stress levels in Brook Trout as a result of rising water temperatures, we will measure the response of different indicators of stress to various temperature treatments. By understanding the base levels of response of stress markers, such as cortisol and heat shock proteins (HSPs), and how they respond to temperature, these markers may be used in the future as measures of heat stress levels. Novel non-invasive sampling methods, such as cortisol in fish scales and HSPs in fin clippings, will be measured in various water temperatures in both the lab and in wild populations and compared to conventional sampling methods, such as plasma cortisol and HSP in tissue samples to confirm their accuracy. We will also measure and compare these levels in related invasive species to determine if they are more tolerant of thermal stress.

Are Catch of Age-3 Lake Trout a Reliable Indicator of Year Class Strength for Lake Ontario Lake Trout?

Changhai Zhu, Jeremy Holden, Lake Ontario Management Unit, Ontario Ministry of Natural Resources and Forestry

Since being extirpated from Lake Ontario in the 1950's, restoring a natural, self-sustaining population of Lake Trout has been a primary fish community objective (FCO) in Lake Ontario. As a part of their Lake Trout management strategy, the Ontario Ministry of Natural Resources and Forestry (OMNRF) and the New York State Department of Environmental Conservation (NYSDEC) jointly stock ~1 million yearling Lake Trout annually in Lake Ontario. Despite relatively consistent stocking numbers, survival of stocked LT remains variable between years. Currently, stocking survival is assessed by the catch of age-3 Lake Trout in the Lake Ontario Management Unit's index gill net program. We find that age-3 Lake Trout are not fully recruited to the assessment gear, which may influence the ability of this data to generate a reliable index of year class strength (YCS). We produced multiple YCS indices based on adult catch data from our index gill net program and compared the results to the YCS index produced by the

catch of age-3 Lake Trout. We found that each of the YCS estimates, in general, produced similar trends, and therefore we concluded that under the conditions of the current assessment program, the age-3 index of YCS for Lake Trout should be reliable despite net selectivity issues. Future directions for this research involve using YCS indices to assess various factors that may affect survival of stocked Lake Trout.

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Oral Presentation Abstracts

Friday February 26, *08:40*
Keynote: *Governmental Fishery Policies for Ontario Waters since Confederation in 1867: Consistent with Conservation Movements in Ecosystemic Contexts?*

Henry A. Regier; University of Toronto

With 62 years of professional experience on fisheries issues in Ontario and elsewhere I infer that the dominant cultural and governmental policy related to our fisheries is a locally-relevant and timely version of a Conservation Movement, CM, that may have waxed and waned in our waters since time immemorial.
To govern fisheries effectively requires information on fish and their natural habitat as well as on human fishers and their cultural habitat. The ancient term 'eco' relates to a living thing together with its home that it has helped to craft through 'evolutionary genesis' from the surrounding environment (e.g. ecologics). Similarly with a living cultural phenomenon (e.g. economics, ekistics, ecunumenistics). So a complex understanding of fisheries ecogenics (e.g. all the above and more) contributes to appropriate governance of fisheries. A CM involves informed and ethical 'management' of ecogenic phenomena. A millennium ago the Aboriginals hereabouts practiced their version of CM, I understand. Since Confederation in 1867, say, the more perceptive and considerate among the European invaders practiced a version of CM that had served as a kind of default policy in their European homelands for centuries. In recent decades there have been efforts to bridge these two ancient CM traditions, as with A/OFRC. American states next to Ontario have practiced versions of CM with small waters but CM has often been shunted aside in large waters of their parts of the Great Lakes. Since the mid-20th Century the Great Lakes Fishery Commission and the American Fisheries Society have implicitly fostered new versions of CM here, as with Adaptive Management and an Ecosystem Approach.

Friday February 26, *09:20*
Talk 1: *Evidence-based conservation and management of fisheries and aquatic resources in Canada.*

Lisa A Donaldson[1,2], Steven J. Cooke[1,2]; [1]Canadian Centre for Evidence-Based Conservation and Environmental Management, Institute of Environmental Sciences, Carleton University; [2]Fish Ecology and Conservation Physiology Laboratory, Department of Biology, Carleton University

Objective scientific evidence and information synthesis are essential for supporting policy and management decisions by environmental and conservation professionals. However, research has revealed that managers often fail to take full advantage of available evidence and instead rely on personal experience or informal input from peers. Imagine if we were to approach medicine with a same "shoot from the hip" attitude! Indeed, the medical and health sciences world relies on highly repeatable, objective and critical methods of evidence synthesis known as "systematic reviews". Recognizing the hugely successful progress in the health sciences, practitioners in conservation science and environmental management are beginning to recognize that similar frameworks can be adapted to their needs. These approaches have been spearheaded by a global collaborative called the Collaboration for Environmental Evidence (CEE). The CEE has six centers around the globe, including the newly established Centre in Evidence-based Conservation and Environmental Management at Carleton University in Ottawa. This presentation focuses on the need for evidence-based conservation and management of fisheries and aquatic resources and introduces a pilot study between Parks Canada and Carleton University using the framework established by the CEE to assess effectiveness of invasive fish removal projects for the restoration of freshwater ecosystems.

Friday February 26, *09:40*
Talk 2: *Effect of sampling gear and effort on the Index of Biotic Integrity in the Huron-Erie Corridor.*

Meagan M. Kindree, Nicholas E. Mandrak; University of Toronto Scarborough

In 1987, the International Joint Commission identified the St. Clair and Detroit rivers as Areas of Concern (AOC) in response to ongoing losses of critical fish and wildlife habitat. Implementation of remedial action plans required aquatic monitoring of these areas using the Index of Biotic Integrity (IBI) as an indicator of ecosystem health. The IBI has traditionally been calculated for AOCs based on fish community sampling using boat electrofishing; however, site conditions in the Huron-Erie corridor are characterized by relatively high water velocity and depth, which may lead to reduced capture efficiency when boat electrofishing techniques are employed. This may lead to biases in species captures (and associated IBI scores) relative to other sites in the Great Lakes basin. This project examined the influence of sampling gear type on the IBI scores based on statistical comparisons of paired fish community data collected using boat electrofishing and benthic trawling conducted in summer and fall of 2011 to 2014. To

ensure sufficient sampling of the Detroit and St. Clair rivers at the site level the change in variance in response to increased sites sampled was calculated to demonstrate how many sites are necessary to decrease the IBI score variance by set targets of 95%, 90%, 75%, and 50%. In addition to testing the effect of gear type and sampling effort, the influence of IBI calculation method (Hamilton 1989, Minns et al.1994, Edwards et al. 2006) was also examined. Results of this study will provide guidance on the development of long-term monitoring protocols in the Huron-Erie Corridor.

Friday February 26, *10:00*
Talk 3: *Pragmatic decision making for Anthropocene fisheries.*

Kevin B. Reid[1], Thomas D. Nudds[2]; [1]Department of Integrative Biology, University of Guelph and Ontario Commercial fisheries' Association; [2]Department of Integrative Biology, University of Guelph

Decision making systems intended to sustain Anthropocene fish populations, fishermen and their communities appear slow to adopt the broad interdisciplinarity evident in more recently advocated approaches to fisheries decision making. We draw upon insights from pragmatism, hermeneutics, Bayesian thinking, operations research and the sociology of organizations to argue that the pragmatic approach is a means for challenging the many barriers to interdisciplinarity and for spanning boundaries such as the science-policy boundary. Pragmatism is a democratic, pluralistic, problem-centered worldview concerned with real-world practice, particularly the consequences of actions. Fisheries decision making must be pluralistic, participatory and, critically, broadly interdisciplinary to qualify as being pragmatic. Pragmatic approaches utilize Bayesian and operation research methodologies, such as Bayesian network models, with their potential to facilitate knowledge integration, discourse and, over time, a hermeneutic fusion of horizons of the various actors despite their disparate cultural, historical, epistemic, and political traditions. While Bayesian and operations research techniques have been shown to be very useful statistical tools for fisheries assessment and management, we show how they also have the capacity to empower boundary spanners, greatly increase the flow of information and ideas across the science-policy boundary, and contribute to a more pragmatic, i.e., pluralistic, anti-skeptical and fallibilistic form of fisheries decision making.

Friday February 26, *10:30*
Talk 4: *Investigating the effects of population size, divergence, and stress on outbreeding in fragmented populations of Salvelinus fontinalis.*

Zachery Wells, D.J. Fraser; Department of Biology, Concordia University, Montreal, Canada

Governments and industries are turning to conservation programs to offset the decline of species abundance worldwide, and an area of concern with these programs is whether or not they can produce self-sustaining populations. As the genetic makeup of a

population is often attributed to its health, the adoption of deliberate outbreeding practices is an area of interest for many of these programs. However, outbreeding outcomes have been highly variable. Using ten wild populations of brook trout (*Salvelinus fontinalis*), we are in the process of studying the effects of outbreeding on fitness-related traits, and investigating how population size, divergence, and stress influence these outcomes. Additionally, thermal tolerance trials were conducted to determine and compare the critical thermal maximum (CTmax) of pure and hybrid brook trout. Gametes were collected from varyingly-sized, isolated populations of brook trout, crossed in-lab, and maintained under common garden conditions. Owing to previous studies in our lab that have quantified population size, habitat characteristics (e. g. water temperature, pH), and genetic divergence (Q_{st}, and F_{st}) for these populations, we have the unique opportunity to combine these factors into a comprehensive analysis of how outbreeding affects wild, isolated, and varyingly-sized populations of a vertebrate species inhabiting a pristine environment. These results will provide guidance to small population and captive-breeding conservation programs when managers are deciding whether to preserve or alter the genetic structure of wild or captive-bred populations at risk, and will be particularly useful for cold-water species.

Friday February 26, *10:50*

Talk 5: *Investigating the drivers of primary production patterns along the south-east shoreline of Lake Huron.*

Samantha Stefanoff[1], Richard Vogt[2], Todd Howell[3], and Sapna Sharma[1]; [1]Department of Biology, York University; [2]Department of Biology, Trent University; [3]Ontario Ministry of the Environment and Climate Change

Observed increases in the occurrence of shoreline fouling by algae in the southeast region of Lake Huron have been attributed to changes in surrounding land use and to the invasion of dreissenid mussels. Here, we quantify the relative influence of land use, water chemistry, spatial patterns, and invasive species on algal production along the shoreline of Lake Huron using water chemistry data collected by the Ontario Ministry of the Environment at 46 sites for the Inverhuron region, and 47 sites for the Point Clark region. An additional 30 sites along the south-east shoreline are used to investigate the influence of invasive dresseinids on algal and macrophyte growth. We developed multiple regression models and used a variation partitioning framework to quantify the variation in chlorophyll *a* concentrations and *Cladophora* biomass/percent cover explained by land use, water chemistry, invasive species, and spatial patterns. Our results suggest that total phosphorus is the most important predictor of chlorophyll *a*, explaining between 62-99% of variation, with both nutrient and chlorophyll concentrations showing spatial structure at the mouths of tributaries and in close proximity to development along the shoreline. In addition, between 13-47% of *Cladophora* biomass/cover was explained by invasive dreissenid mussels. This study demonstrates that nutrients and algae are spatially contingent, which highlights the need to include spatial variability in water quality monitoring techniques and management decision making.

Friday February 26, *11:10*
Talk 6: *Recolonization Trends of Fish Communities Following the Restoration of a Great Lakes Coastal Wetland.*

Natalie A. Rook[1], Nicholas E. Mandrak[1] and Scott Reid[2]; [1]University of Toronto; [2]Ontario Ministry of Natural Resources and Forestry

The coastal wetlands of the Great Lakes are ecologically diverse and provide numerous functions for native species including recruitment and early survival of fishes. Unfortunately, the Great Lakes coastal wetlands are in decline due to various anthropogenic factors including invasive species. An invasion by *Phragmites australis*, a perennial grass species, in Long Point Crown Marsh, Lake Erie, reduced the amount of open-water habitat for wildlife. As part of an initiative to increase habitat heterogeneity and restore natural wetland function, physical dredging to re-create open-water habitat occurred 2008 to 2012. This study assesses the recolonization trends of fish communities by examining changes in species richness, population density, and community composition, 2012-2014, in four created and two reference ponds. Water chemistry and vegetation were also examined to determine how they influenced the fish communities. Fishes colonized the created ponds immediately after dredging, but ponds showed variation in population density and community composition when compared to the reference ponds. Also, there were differences in richness and population density between the two newly created ponds, which showed that not all man-made habitats are the same quality. Water chemistry and vegetation accounted for very little variation in the communities indicating that other factors, such as biotic interactions between fishes, productivity, and connectivity, should also be taken into account when restoring wetlands in the future. This will help ensure that future restoration will maximize the value of the habitat for fishes.

Friday February 26, *11:30*
Talk 7: *Use of woody debris in channel restoration.*

Heather Amirault; Stantec

The science of stream restoration continues to evolve. With the protection of fish and fish habitat as the primary driver for stream restoration in Canada, practitioners continue to seek new ways to improve fish habitat within restored streams. Wood has proven to be an effective replacement for rock in many instream structures and bank protection structures including log j-hooks, constructed riffles; and, wood toe protection. The wood is as effective as rock but much better at providing fish habitat. Wood has been used for more than a decade in the US and is being applied more frequently in Canada. Stantec is using this wood in numerous projects in Canada on both large and small systems. We anticipate that wood will become the norm in stream restoration projects in the near future.

Friday February 26, *11:50*
Talk 8: *The need for more than science – understanding barriers can be as important as having the right evidence.*

Vivian Nguyen[1,2], Nathan Young, Scott G. Hinch and Steven J. Cooke[1,2]; [1]Canadian Centre for Evidence-Based Conservation and Environmental Management, Institute of Environmental Sciences, Carleton University; [2]Fish Ecology and Conservation Physiology Laboratory, Department of Biology, Carleton University

With increasing pressure and competition on natural resources, the future sustainable use of fishery resources will require management regimes based on the best possible science. Telemetry technology is a powerful tool to research the ecology and dynamics of our fishery resources. The technology has been improving and used at an unprecedented rate, providing fisheries managers with new knowledge that fill gaps that could not be filled previously with traditional research methods. Yet there exist cases, such as the Fraser River salmon fishery, where over a decade of information have been generated using telemetry but this knowledge have not been fully integrated into management frameworks. Why is that? I plan to discuss potential factors that influence the use of evidence generated from telemetry technology in fisheries management practices, policies and decision-making.

Friday February 26, *1:00*
Talk 9: *A Summary of Ontario's Early Effort's to Culture at Risk Mussel Species"*

Christopher Wilson; Ontario Ministry of Natural Resources and Forestry

This project involves developing specialized husbandry expertise for culturing "at risk" freshwater mussels using techniques developed in other jurisdictions, and subsequently refining those techniques in Ontario, so that MNRF's Fish Culture Program is able to support expected future culture and stocking-based recovery efforts when asked to do so by appropriate management authorities (e.g., lake management units, districts, conservation authorities).
The recovery plans for each of the species that have been selected recommend the use of reintroduction and/or artificial propagation to support recovery efforts, recommendations that were subsequently confirmed as appropriate by panel of experts which included MNRF, DFO and NGO research scientists and SAR specialists.
The species being cultured include Wavy-rayed Lampmussel, Northern Riffleshell, Snuffbox and Kidneyshell.

Friday February 26, *1:30*

Talk 10: *A summary of Ontario's contributions to a bi-national initiative to restore an extirpated species, Coregonus hoyi, to Lake Ontario.*

Ryan Zheng[1], Timothy D. Drew[1], Steven R. LaPan[2], Andy Todd[1], John M. Dettmers[3], Mark E. Holey[4], James H. Johnson[5], Trevor E. Pitcher[6], Alex Presello[6], Kevin K. Loftus[1]; [1]Ontario Ministry of Natural Resources and Forestry; [2]New York State Department of Environmental Conservation; [3]Great Lakes Fishery Commission; [4]U.S. Fish and Wildlife Service; [5]U.S. Geological Survey; [6]University of Windsor

Until the 1950's, Lake Ontario was home to four species of deep water cisco. Collectively, these species formed the most abundant and largest biomass prey community in the lake, and were critical to species like Lake Trout and Burbot. Unfortunately, all four species were extirpated from the lake in the last century due primarily to the combined effects of over-harvest and invasive species (esp. Alewife and Rainbow Smelt). Today, only the shallow water form of cisco, Lake Herring (*Coregonus artedi*), remains in in the lake. Lake Trout and salmon that feed on Alewife and Rainbow Smelt can experience reproductive failure due to vitamin B deficiency resulting from thiaminase activity. Fisheries managers and research scientists believe that the time is right to reintroduce Bloater to Lake Ontario which, if successful, would provide more food choices for native predators like Lake Trout and salmon and should improve reproductive success. In 2011, the (then) Ontario Ministry of Natural Resources and the New York State Department of Environmental Conservation developed a draft plan for the restoration of deep water ciscoes to Lake Ontario. The goal of the plan is to restore a self-sustaining population within 25 years. The plan is consistent with the bi-national fish community objectives for the lake which call for the promotion of a diversified native prey fish community including deep water ciscoes, Slimy Sculpin and Deepwater sculpin. This presentation describes the early efforts of a broad partnership of agencies to develop a reliable source of gametes for Bloater, *C. hoyi*, based initially on wild collections from Lake Michigan, to develop captive brood stocks for the species, and to develop husbandry practices that will subsequently form the cornerstone of a culture and stocking program. Good progress has been made in all areas since gametes were first obtained from Lake Michigan in 2011.

Friday February 26, *1:50*

Talk 11: *The synergistic and interactive effects of angler behaviour, gear type, and fish behaviour on hooking depth in passively angled fish*

Lee Gutowsky, Brittany Sullivan, Alexander D. M. Wilson, Steven J. Cooke; Fish Ecology & Conservation Physiology Lab, Carleton University

Sublethal behavioural and physiological impairment for caught and released fish can be linked to angler behaviour (e.g., experience), gear type (e.g., hook size), and fish behaviour (e.g., aggression). The latter is usually only measured post-capture whereas behaviour prior to hooking is unknown. Moreover, angler behaviour, gear type, and fish behaviour are often evaluated independently to explain sublethal impairment suffered

during the angling process. Here we use an underwater video camera, fixed to the fishing line, to record the behaviour of wild sunfishes (*Lepomis* spp.) as they approach and handle one of four treatments of baited hook under a passive (i.e., float fishing) angling scenario. Angler reaction time was also measured as the difference between the fish strike and hook set. The putative explanatory variables were together analysed to explain length-corrected hooking depth. Angler performance (hooksets/min) varied over the two day study, where hooksets/min decreased with small hooks and increased with large hooks. Of the eighty sunfish captured, 9 were deeply hooked. Based on AIC, the most appropriate extension for the candidate set of models to explain length-corrected hooking depth was a crossed random effects design including sampling day and angler. AIC model selection and model averaging found the top models included the terms: angler reaction time, fish approach to the bait (cautious, deliberate, aggressive), hook size (small or large), and the interaction between fish approach to the bait and hook size. The model-averaged fitted values indicated that length-corrected hooking depth increased most dramatically with angler reaction time when fish aggressively approached a baited hook. A cautious approach to a large baited hook led to a deeper length-corrected hooking depth than a similar approach to a small baited hook. These results illustrate the seldom explored synergistic and multiplicative relationships between the well documented sources of impairment for angled fish.

Friday February 26, *2:10*
Talk 12: *Developing a novel detection technique for rare freshwater fishes.*

Rowshyra A. Castaneda[1], Nicholas E. Mandrak, Olaf L.F. Weyl[2]; [1]Department of Ecology and Evolutionary Biology, University of Toronto Scarborough; [2]South African Institute for Aquatic Biodiversity

The ability to properly assess species abundances, distributions and diversity is crucial for successful conservation management. However, detection of rare species poses difficulties for conservation planning. Rare species, such as species at risk and early invaders, must be detected in order to increase the predictive power of occupancy estimations–important for effecting suitable protected areas or early detection and rapid response. Sampling for rare fishes, such as species at risk, may be restricted due to potential stress and mortality from handling in the field. The inability to sample fishes at risk reduces our ability to properly monitor populations after recovery strategies and action plans have been implemented. Therefore, developing new detection methods that do not require physical handling of these species at risk is required. Underwater visual analysis (UWVA) is one such passive method gaining popularity in freshwater systems. The UWVA method could also be used to detect early invaders and optimize the success of eradication attempts. To develop this novel detection tool, we compare traditional sampling methods (seine and fyke nets) to the novel method (UWVA) in Canadian and South African watersheds. We evaluate the use of underwater cameras (GoPros) in detecting and quantifying fishes in ponds and streams.

Friday February 26, *2:50*
Talk 13: *An overview of the aquatic ecosystem classification project OMNRF has been developing.*

Nicholas Jones; River and Stream Ecology Lab, Ontario Ministry of Natural Resources and Forestry

The Ontario Aquatic Ecosystem Classification (AEC) project covers all of Ontario. The AEC will provide a universal and consistent spatial framework for Ontario's flowing waters. It will capture the ecological nature of streams and rivers. We developed a provincial inventory of >750,000 stream reaches and their characteristics based on GIS data e.g. elevation, geology, climate. We have programed a software tool that clusters the reaches into larger stream segments based on reach characteristics including abrupt and gradual changes in stream size. Further clustering across watersheds greatly reduces complexity for better understanding and management. We plan to validate the classification by working with clients during development and testing.

Friday February 26, *3:10*
Talk 14: *Protecting Ontario's Lake Trout: A Case Study of the Intersection between Science and Policy.*

Warren I. Dunlop; 502 Hunter St. W. Peterborough, ON, K9H 2N1

For over forty years, the Ontario Ministry of Natural Resources has formally promoted a science (or evidence) based approach to fisheries management through its various fisheries strategic plans: the Strategic Plan for Ontario Fisheries (SPOF 1976), SPOF II (1992), and Ontario's Provincial Fish Strategy (2015). However, the use of evidence-based fisheries management in Ontario has a history that pre-dates these government strategic planning exercises. This case study will illustrate how evidence-based decision making has guided the management of Ontario's Lake Trout (*Salvelinus namaycush*) resource, and highlight the sometimes complicated intersection of science and policy development.

Friday February 26, *3:30*
Talk 15: *The influence of groundwater extraction on long-term trends in Brook Trout, Salvelinus fontinalis, population (1996, 1997 -2015) In Monora Creek, Orangeville, Ontario.*

Megan Lloyst; Gord Wichert SLR Consulting (Canada) Ltd.

The monitoring of fish and fish habitat is important to document the ongoing health of the upper branch of Lower Monora Creek. Municipal Production Wells have the potential to affect Monora Creek and the water taking is permitted in a fashion to prevent adverse effects. We applied a trend through time analysis to determine if

groundwater extraction is influencing long-term trends in Brook Trout population (1996, and 1997 to 2015). To complete our analysis, a multi-disciplinary monitoring program was developed to collect biological, hydrological and hydrogeological information from Monora Creek. Under normal conditions Brook Trout habitat is supported where there is groundwater upwelling. Brook Trout require a narrow window of water temperatures which groundwater keeps cold in the summer and relatively warm in winter (non-freezing). Groundwater baseflow sustains the creek when there is no precipitation, providing habitat. Brook Trout spawn in the autumn and their eggs rely on groundwater flow-through over the winter before the fry emerge in early spring. lf Production Well pumping inadvertently draws down the water table, then the direction of groundwater flow is reversed thereby reducing creek flow, water depths, and habitat by inducing more shallow pools, and providing less depth in run and riffle morphology. Most importantly there is no thermal buffering by groundwater and Brook Trout egg incubation stops as temperatures drop in the winter and the water freezes (killing the eggs). Data collected and analyzed to date do not suggest that pumping rates are influencing Brook Trout spawning success or abundance. A strong increase or decrease trend in Brook Trout biomass over the monitoring program has not been observed. Groundwater extraction data collected from Production Wells during observed spawning activity were compared to the number of young-of—year (YOY) Brook Trout captured in the following year's biomass survey. This comparison shows that there is no clear increasing or decreasing trend and a decrease in extracted groundwater does not correspond with observed increases in the number of positive redds or an increase in the number of YOY Brook Trout.

Saturday February 27, *08:30*
Talk 16: *Salmon use of a threshold channel.*

Jeff Muirhead; Stantec

Many stream restoration projects in North America are situated in an urban or semi-developed environment. Under these circumstances, restoration designs are frequently required to maintain the same channel plan and profile over a wide range of flood flows, and must do so recognizing the modified flow regime and decreased bedload from the altered land use in the watershed. Threshold channels are often implemented to satisfy these objectives; riffles are composed of large particles which cannot be moved over the range in channel flows, maintaining channel location and geometry despite no coarse material being supplied by the upstream watershed. However, restoration designs are often also required to provide aquatic habitat to compensate for development activities. The ability of threshold channels to provide aquatic habitat has been a topic of debate between regulators and designers alike, resulting in difficulties meeting biological and hydraulic/geomorphic objectives. Here, we present an instance of salmon migrating and spawning in a threshold channel, as an example of restoration design success from a biological perspective and as a starting point for discussion between biologists, geomorphologists, and river engineers.

Saturday February 27, *08:50*

Talk 17: *Misbehaving parents: do smallmouth bass change their swimming behaviours during parental care after an angling event?*

Dirk A. Algera[1], Jacob W. Brownscombe[1], and Steven J. Cooke[1,2]; [1]Fish Ecology and Conservation Physiology Laboratory, Biology Department, Carleton University; [2]Canadian Centre for Evidence-Based Conservation and Environmental Management, Institute of Environmental Sciences, Carleton University

Black bass (i.e., largemouth bass, *Micropterus salmoides* and smallmouth bass, *Micropterus dolomieu*), popular sportfish species in Ontario, are often accidentally caught by anglers during their reproductive period. Parental care is ubiquitous in black bass, where the male provides sole parental care for the developing brood for an extended duration until they reach independence. Throughout the parental care period, nesting males expend time and energy undertaking a variety of swimming behaviours related to protecting the brood from predators and tending to the nest. Tri-axial accelerometers, devices designed to measure fine scale movements on a three dimensional plane, are now commonly used to monitor fine scale behaviours of wild animals. The objective of this research was to determine if nesting male smallmouth bass change their swimming behaviours after being subjected to an angling event. Tri-axial accelerometers were externally attached for 4 days to nesting smallmouth bass guarding eggs 1-4 days old. In addition to accelerometer attachment, treatment group fish either received a 3 minute air exposure, or were recovered for up to 2 minutes using an open mouth figure-8 technique, emulating common post-catch fish handling strategies used by anglers. Fish activity levels and a variety of fine scale swimming behaviours were characterised and statistically analysed testing for any differences evident among control (accelerometer only), 3 minute air exposure, and figure-8 recovery treatment groups.

Saturday February 27, *09:10*

Talk 18: *Impacts of Climate Change on the Ecosystem of Sparkling Lake Through Shifts in Lake Ice Phenology; 1981-2015.*

Bailey Hewitt and Sapna Sharma; Department of Biology, York University

Over the past century, atmospheric temperatures on Earth have increased by approximately 1 ^{o}C and throughout this time Northern Hemisphere lake ice breakup has become earlier, freeze up has become later and ice duration has become shorter. Lake ice phenology is an indicator of climate change and can be defined as the seasonal breakup, freeze up and duration of ice cover on lakes. The rates of change of these trends have increased over the last few decades. Our study examines how climate-induced changes on lake ice are influencing the ecosystem structure of Sparkling Lake, Wisconsin, an inland boreal lake. The first objective is to identify how the lake ice phenology has changed on this lake over the last 35 years. The second objective is to determine how the changes in lake ice phenology influenced the lakes' ecosystem physically, chemically and biologically. The data for Sparkling Lake is provided by the North Temperate Long-Term Ecological Research Network's online database. Preliminary results suggest that

ice breakup is 1.56 days/decade earlier, lake freeze up is 1.4 days/decade later and lake ice duration is 2.96 days/decade shorter over the last 35 years. This research will further our knowledge as to how climate change is affecting our lake temperatures, productivity, and potentially eventually reducing ecosystem services, changing the community composition of phytoplankton, zooplankton, and fish, in addition to decreasing our lakes' biodiversity.

Saturday February 27, *09:30*
Talk 19: *How Ontario's anglers behave: Insights in the digital age.*

Timothy Martin[1], Paul Venturelli[1], Len Hunt[2], Erin Dunlop[2]; [1]Department of Fisheries, Wildlife and Conservation Biology, University of Minnesota, Twin Cities; [2]Ontario Ministry of Natural Resources and Forestry

Angler behaviour is arguably the final frontier of recreational fisheries science. Not only are anglers responsible for fishing effort and catch on a landscape, but also the flow of revenue and the spread of invasive species. Conventional approaches to describing angler behaviour (e.g. diaries, interviews, surveys) vary widely in effort, cost, and efficacy; and tend to produce retrospective data that are limited in time or space. However, anglers generate valuable yet unexploited behaviour data via their use of digital media such as smartphone apps, social media, online fora, and cell phone use in general. To demonstrate that digital data have value, we analyzed data gathered from a smartphone app (iFish Ontario) and various online fora. Using geospatial density and network analyses, we not only determined the relative popularity of water-bodies and quantify angler traffic among them, but also showed how these patterns varied over fine temporal scales. These results are consistent with but also improve upon results from more conventional and costly methods. Overall, our study, and a growing body of literature, shows that digital media are a unique opportunity to efficiently collect conventional and novel data related to the resource and its users.

Saturday February 27, *09:50*
Talk 20: *Consistent individual differences in behaviour of Sea Lamprey: Implications for control via trapping***.**

A.R. McLean and Robert L. McLaughlin; Department of Integrative Biology, University of Guelph

We tested if variation in individual behaviours may explain why few Sea Lamprey (*Petromyzon marinus*) enter traps upon encounter. Trapping is used to control invasive species, but in many cases we see lower than desired trapping success. This is true for Sea Lamprey, an invasive species in the Upper Great Lakes and the target of binational control. We hypothesized that this is due to consistent individual differences in the behaviour of lamprey, where some of those behaviours are more susceptible to trapping. To test this, we compared the behaviours of lamprey captured in traps with those captured by electrofishing. We developed behavioural tests to assess if lamprey

show individual differences in activity, latency to exit a refuge, and response to a predator cue. Individual lamprey differed consistently in all three of the behaviours measured. Trapped lamprey were on average more active and decreased their activity in the presence of a predator cue compared to those captured by electrofishing. These results suggest that the design of effective trapping of invasive species requires an understanding of the functional effects of individual behaviours.

Saturday February 27, *10:30*
Talk 21: *Ontario's Provincial Fish Strategy: Fish for the Future.*

Helen Ball; Species Conservation and Policy Branch, Ontario Ministry of Natural Resources and Forestry

Ontario's strategic direction for fisheries management was provided in the Strategic Plan for Ontario Fisheries II (SPOF II), which was released in 1992. In the last 20 years, numerous changes have emerged that merited updating the strategic direction. Some highlights include:

- New strategic direction regarding biodiversity, landscape management, and risk.
- New stressors (e.g. invasive species, climate change).
- Supreme Court decisions regarding Aboriginal and Treaty Rights.

The Provincial Fish Strategy provides up-to-date direction for the management of Ontario's fish, fisheries and supporting ecosystems.

Saturday February 27, *10:50*
Talk 22: *The effect of climate change and water level fluctuations on the structure and function of inland boreal freshwater lakes.*

K. Gaibisels and S. Sharma; Department of Biology, York University

Lakes across the Northern Hemisphere are experiencing both seasonal and long-term changes in water levels, with implications for physical, chemical, and biological aspects of the ecosystem. Over the next century, conditions are projected to become hotter and wetter, but responses in water levels and consequently lake ecosystems are difficult to predict. This study investigates how recent changes in climate have affected the structure and function of Sparkling Lake, Wisconsin. My first objective was to develop a model describing changes in lake level using climate drivers at local, regional, and global scales. My second objective was to identify changes in the components of the ecosystem resulting from water level fluctuation. The lake data used for this study was collected from the North Temperate Lakes Long Term Ecological Research database, and climate data was collected from the National Oceanic and Atmospheric Administration database. Sen's slopes were used to estimate the rates of change in climate and water levels, regression trees were used to determine important predictors of long term changes in lake levels, and Redundancy Analyses were used to examine changes within lake communities, from plankton to fish. Since 1981, the climate of the region of Sparkling Lake was found to have become warmer and drier, resulting in a drop in

water levels of 0.8 m since 1984. On a seasonal scale, the Pacific Decadal Oscillation and the El Nino Southern Oscillation were important predictors of water level fluctuations, and local precipitation and air temperature were important at the annual scale. The drop in levels has resulted in increased water clarity, increased algal growth in summer, and a loss of littoral habitat and refuge. By defining the relationships between ecosystem processes, population dynamics, and the hydrological regime of the lake, we may have a greater chance of predicting the long term impacts of climate change. This would allow conservation biologists and managers to better define and prioritize projects for adaptation.

Saturday February 27, *11:10*

Talk 23: *Behaviour of Atlantic salmon released by recreational anglers: Insights from electronic tags.*

Robert J. Lennox[1], Ingebrigt Uglem[2], Eva B. Thorstad[2], Frederick G. Whoriskey[3], Ola H. Disreud[2], Martin Rognli Johansen[2], and Steven J. Cooke[1]; [1]Fish Ecology and Conservation Physiology Laboratory, Department of Biology, Carleton University; [2]Norwegian Institute for Nature Research; [3] Ocean Tracking Network, Dalhousie University

Catch-and-release is becoming a popular strategy for managing recreational Atlantic salmon fisheries in Canada and abroad. Telemetry studies have demonstrated high survival of salmon released by anglers, however, catch-and-release may have important sublethal consequences that manifest in individual behaviour after release. Using radio-transmitting tags affixed to salmon released by anglers, we analyzed behaviour of salmon after catch-and-release in Atlantic salmon fishing rivers. Tagging and tracking data from several rivers identified altered upriver some evidence of altered migratory behaviour of salmon relative to a control group and gear avoidance among recaptured salmon. Altered behaviour has important consequences for migrating salmon in the context of reproduction, given that salmon are migrating towards specific spawning territory within their natal rivers. Moreover, behavioural effects of catch-and-release provide interesting insight into the salmon fisheries management given the economic and cultural importance of salmon to many coastal communities.

Saturday February 27, *11:30*

Talk 24: *The effects of climate change on biotic interactions between walleye and smallmouth bass.*

Lianna Lopez; York University

Climate change is an important determining factor of future freshwater species distributions. This can lead to changes in species composition and therefore, alter future biotic interactions. Our objective is to predict the changes in the co-occurrence of walleye, a native coolwater fish, and smallmouth bass, an invasive warmwater fish, in 2050 and 2070. We obtained historical fish occurrence and lake morphology data from

the Ontario Ministry of Natural Resources (OMNR) Aquatic Habitat Inventory and Broadscale Monitoring programs for 9641 Ontario lakes and 126 future climate change scenarios from the Intergovernmental Panel on Climate Change for 2050 and 2070. Across Ontario, we found that walleye-bass co-occurrence is predicted to increase by 7.9%-12.6% by 2050 and 8.7%-13.1% by 2070. However, this pattern is not consistent spatially across Ontario as walleye are predicted to become extirpated in southern Ontario and shift their range northwards, whereas smallmouth bass are predicted to expand their range northwards throughout Ontario. As such, we found that walleye-bass co-occurrence may decrease in southern Ontario under climate change scenarios. In northern Ontario, novel competitive interactions between walleye and smallmouth bass may become apparent exacerbating the vulnerability of walleye populations in Ontario to climate change.