AMERICAN FISHERIES SOCIETY

ONTARIO CHAPTER

ANNUAL GENERAL MEETING

March 10 – 12, 2023

Bayview Wildwood Resort, Severn Bridge, ON

"Expanding our view: Advancement in monitoring techniques"

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1 Wildwood Inn
• Reception / Guest Services Desk
• Echoes Dining Lounge & Crusoe Room
• BW Market (lower level | lakefront)
• Winter Sports Shop (lower level | lakefront)
• Ice & Vending Machines
2 Lakeshore House: Indoor Recreation Centre
• Kids Fun Zone with indoor treehouse
• Games Room
• Fitness Centre
• Indoor Pool
3 Cedar East & West
• Meeting Room (lower level | lakefront of Walton House)
4 Glyde Hall
• Meeting Room
5 The Boathouse
• Summer Sports Equipment Desk
6 Inflatable Waterpark
7 Outdoor Pool
8 Beach
BAYVIEW
WILDWOOD RESORT

AMERICAN FISHERIES SOCIETY
ONTARIO CHAPTER

ANNUAL GENERAL MEETING

March 10 – 12, 2023
Bayview Wildwood Resort, Severn Bridge, ON

"Expanding our view: Advancements in monitoring techniques"

Friday March 10th

5:30-on **Arrival, Registration (Reception/Service Desk – Wildwood Inn)**

7:00-10:00 **Opening Mixer (Glyde Hall)**

Saturday March 11th

07:30 **BREAKFAST** ***(****Echoes Dining Lounge* **– Wildwood Inn)**

08:30 **GREETING AND CONFERENCE OUTLINE (***Cedar Room* **– Walton House)**
Zachery Wells, AFS-OC President

08:45 OPENING CEREMONY
Gary Pritchard, Giniw/Golden Eagle

Session 1

09:00 ***Keynote:*** *Linking fish movements to environmental conditions in the Great Lakes basin.*
Dr. Chris Vandergoot

09:40 ***Talk 1:*** *An interdisciplinary evaluation of multi-species fish connectivity in Canada's historic Rideau Canal waterway.*
Jordanna Bergman ***(Student Talk)***

10:00 **COFFEE, TRADE SHOW, POSTER SESSION (***Cedar Room* **– Walton House)**

Session 2

10:20 ***Talk 2:*** *A comparative analysis of the behavioural and fitness consequences of using chemical anaesthesia, electroanaesthesia, and electrostunning on a wild fish.*
Connor Reid ***(Student Talk)***

10:40 ***Talk 3:*** *Evaluation of light as a behavioral guidance mechanism to reduce turbine-related mortality of out-migrating American Eel on the St. Lawrence River.*
Cole Macleod *(Student Talk)*

11:00 ***Talk 4:*** *Detecting Sea Lamprey attacks on Lake Trout with implantable archival tags.*
Connor Reeve *(Student Talk)*

11:20 ***Talk 5:*** *Exploring the impact of juvenile fish exclusion on the sampling efficiency of larval light traps.*
Jennifer Powell *(Student Talk)*

11:40 ***Talk 6:*** *Classifying agricultural drains using fish communities: Comparison of conventional and eDNA methods.*
Markelle Morphet *(Student Talk)*

12:00 **LUNCH (*Echoes Dining Lounge* – Wildwood Inn), TRADE SHOW & POSTER SESSION (*Cedar Room* – Walton House)**

Session 3

1:00 ***Talk 7:*** *Bighead Carp overwintering under climate change — spawning, survival, and implications for invasion.*
Erik Dean (Student Talk)

1:20 ***Talk 8:*** *A Fish out of winter: Winter energy acquisition and storage influence spring reproduction in a warm-water Fish.*
Timothy Fernandes *(Student Talk)*

1:40 ***Talk 9:*** *Toward area-based effort for boat electrofishing in the Toronto Region: An accidental experiment.*
Matthew Fraschetti

2:00 ***Talk 10:*** *Changes in the freshwater fish fauna of Canada since 1973.*
Dr. Nicholas Mandrak

2:30 **COFFEE, POSTER SESSION, TRADE SHOW (*Cedar Room* – Walton House)**

3:00 ***Talk 11:*** *AFS Parent Society Update.*
Gary Whelan (AFS Second Vice President)

3:30-4:30 **ANNUAL BUSINESS MEETING (*Cedar Room* – Walton House)**

4:30-6:00 **POSTER SESSION & TRADE SHOW (*Cedar Room* – Walton House), ICE FISHING**

6:00-7:00 **DINNER (*Echoes Dining Lounge* – Wildwood Inn)**

7:00-10:00 **MENTORSHIP EVENT, RAFFLE AND SOCIAL (Glyde Hall)**

Sunday March 12th

07:30 **BREAKFAST (*Echoes Dining Lounge* – Wildwood Inn)**

Session 4:

08:40 ***Keynote Talk****: Molecular biomonitoring with DNA barcodes and environmental DNA.*
Dr. Robert Hanner

09:20 ***Talk 12:*** *An aquatic species at risk threat assessment and prioritization exercise for the Lower Thames Valley Conservation Authority watershed.*
Vicki McKay

09:40 ***Talk 13:*** *Consequences and mechanisms of intraspecific ecological divergence along the benthic-pelagic axis in Arctic Charr (Salvelinus alpinus).*
Sarah Steele

10:00 **COFFEE & POSTER SESSION EVALUATION (*Cedar Room* – Walton House)**

10:20 ***Talk 14:*** *Validation of non-lethal sampling methods in freshwater fishes.*
Laura Haniford *(Student Talk)*

10:40 ***Talk 15:*** *Why care about fish movements and why do they matter to fish and ecosystems.*
Gary Whelan

11:00 **PRESENTATION OF STUDENT AWARDS & CONFERENCE WRAP (*Cedar Room* – Walton House)**

12:00-1:00 **LUNCH (*Echoes Dining Lounge* – Wildwood Inn)**

Oral Presentation Abstracts

Saturday March 11th, 09:00
Keynote: *Linking fish movements to environmental conditions in the Great Lakes basin.*

Dr. Chris Vandergoot* and Dr. Aaron Fisk
Michigan State University and University of Windsor.
*** Presenting Author**

Acoustic telemetry has revolutionized our understanding of fish movement and behaviour and contributed to fishery management and conservation around the globe. Arguably the impact of acoustic telemetry on fish has been greatest in the Great Lakes basin, through the creation and development of the Great Lakes Acoustic Telemetry Observing System (GLATOS). Beginning in 2010, GLATOS has provided leadership in the use of and training for acoustic telemetry, a user-friendly web-based data portal, and the development of collaborations and coordinated infrastructure coordination through the basin. On a similar trajectory to acoustic telemetry, the deployment of in situ instruments and autonomous underwater vehicles (AUVs), for example the Real Time Aquatic Ecosystem Observation Network (RAEON), to collect limnological data has grown in the Great Lakes. These comprehensive environmental datasets offer new opportunities to explore the factors that drive fish movements, distributions, and behavior, and to predict the impacts of continuing environmental change. This presentation will provide an overview of GLATOS and RAEON and some of the research they have supported and discuss future opportunities.

Saturday March 11th, 09:40
Talk 1: *An interdisciplinary evaluation of multi-species fish connectivity in Canada's historic Rideau Canal waterway.*

Jordanna N. Bergman[1]*, Joseph Bennett[1], Valerie Minelga[2], Chantal Vis[3], Aaron Fisk[4], Steven Cooke[1]
[1]Department of Biology, Carleton University, Ontario, Canada
[2]Ontario Waterways, Parks Canada, Ontario, Canada
[3]Protected Areas Establishment and Conservation Directorate, Parks Canada, Quebec, Canada
[4]School of the Environment, University of Windsor, Ontario, Canada
*** Presenting Author**

Interconnected freshwater systems, like artificial waterways, are now pervasive globally and have facilitated countless invasions. Most waterways are linked by barriers (e.g., lockstations), providing an opportunity to selectively restrict

invasive fish without negating connectivity to native species. However, the ecological connectedness across a waterway is often unknown, make it difficult to apply selective fragmentation efforts. Here, we blended acoustic telemetry (native Largemouth Bass & Northern Pike, and invasive Common Carp; N=225) and mark-recapture (15 species; N=9563) data with operation and biotic data to evaluate barrier passability at ten lockstations over five years (2018-2023) in the Rideau Canal Waterway. This 202-km navigable route forms a hydrological link between the Ottawa River and Lake Ontario, connected by 23 lockstations. Our results suggest barriers minimize, but not entirely restrict, connectivity. We documented 36 passage events by 26 native fishes at nine lockstations, mostly in the spring. No Common Carp passages were recorded; movements indicated carp favoured high-flow areas downstream of dams, regions with no pathway upstream. Interestingly, only seven passages were recorded in 2020 – the year of reduced human mobility due to COVID-19 restrictions – implying potential effects of the "anthropause" on connectivity. We discuss consequences of season-, direction-, and species-specific passages, and other fish interactions with infrastructure. Our work informs evidence-based management planning to support conservation actions in North American waterways and beyond.

Saturday March 11th, 10:20
Talk 2: *A comparative analysis of the behavioural and fitness consequences of using chemical anaesthesia, electroanaesthesia, and electrostunning on a wild fish.*

Connor H. Reid[1]*, Luc LaRochelle[1], Jamie C. Madden[1], Laura S.E. Haniford[1], Declan Burton[1], Jonathan D. Midwood[2], Steven J. Cooke[1]
[1] Fish Ecology and Conservation Physiology Lab, Department of Biology, Carleton University, Ottawa, ON, K1S 5B6
[2] Fisheries and Oceans Canada, Great Lakes Laboratory for Fisheries and Aquatic Sciences, 867 Lakeshore Rd., Burlington, ON, L7S1A1, Canada
*** Presenting Author**

In fisheries science, chemical anaesthesia and electrical immobilisation are often studied in laboratory or aquaculture settings with little focus on post-release behaviours of fish in the wild. We used nest-guarding Smallmouth Bass (*Micropterus dolomieu*) as a model species to investigate the relative impacts of chemical anaesthesia, electroanaesthesia with gloves, and electrostunning on natural behaviours and reproductive success in situ. Chemical anaesthesia provided the best balance of anaesthesia versus potential for parental care impairment, yet it can be challenging in field settings because of concerns such as induction/recovery times, withdrawal holding periods, and chemical disposal. Electroanaesthesia with gloves did not noticeably impair parental care behaviour and allowed for immediate release but failed to fully immobilize some fish. Electrostunned fish took much longer to return to their nests and had higher

likelihoods of impaired parental care. We discuss the suitability of each technique with respect to welfare and practical considerations, and we explore broader implications of anaesthesia and electro-immobilisation on wild fish behaviour.

Saturday March 11th, 10:40
Talk 3: *Evaluation of light as a behavioral guidance mechanism to reduce turbine-related mortality of out-migrating American Eel on the St. Lawrence River.*

M. E. Cole MacLeod*[1], The Eel Passage Research Center, a bi-national team of government, industry and academic partners spanning 15 institutions.
[1]Fish Ecology and Conservation Physiology Laboratory, Carleton University
*** Presenting Author**

At the Moses-Saunders Hydroelectric Dam, the number of eels observed migrating up the St. Lawrence River into Lake Ontario has declined 95-99% since the 1970s. Cumulative anthropogenic mortality while migrating out of Lake Ontario and down the St. Lawrence has been estimated at 53%, three quarters of which is due to hydroelectric dams. There is a need for innovation to develop new mechanisms to reduce turbine mortality. Behavioural guidance using LED lighting has proved effective in a laboratory environment, yet, there have been no management scale evaluations. A 216 m LED light array was installed upriver of the Iroquois Dam on the St. Lawrence River for the purposes of this study. We describe preliminary results from a study where 400 mature eels were implanted with acoustic tags in Lake Ontario to be detected by an array of acoustic receivers near the light array. If eels can be guided with light it provides opportunities for reducing turbine mortality by directing eels toward safe passage or to collection facilities for trap and transport.

Saturday March 11th, 11:00
Talk 4: *Detecting Sea Lamprey attacks on Lake Trout with implantable archival tags.*

Connor Reeve*[1], Scott M. Miehls[2], Michael R. Lowe[2], Jacob W. Brownscombe[3],[4], Steve Cooke[1], Mary Moser[5], Jean V. Adams[6]
[1]Fish Ecology and Conservation Physiology Laboratory, Department of Biology and Institute of Environmental and Interdisciplinary Science, Carleton University
[2]USGS Hammond Bay Biological Station,
[3]Great Lakes Laboratory for Fisheries and Aquatic Sciences, Fisheries and Oceans Canada
[4]Department of Biology, Carleton University
[5]NOAA National Marine Fisheries Service
[6]USGS Great Lakes Science Center
*** Presenting Author**

Sea Lamprey (*Petromyzon marinus*) remains problematic to the restoration of Lake Trout (*Salvelinus namaycush*) in the Greats Lakes. Estimates of Sea Lamprey-induced mortality help to assess the efficacy of Lake Trout rehabilitation programs; however, estimates can only be derived from Sea Lamprey wounding rates in collected Lake Trout which is an inadequate predictor of mortality. Direct field observations are needed to better assess Sea Lamprey attack rates and attack lethality in wild Lake Trout. Advancements in implantable tags are improving our ability to examine fine-scale behaviour in wild fish and may be useful in detecting Sea Lamprey attachments. Therefore, we experimentally implanted Lake Trout with archival tags that record heart rate and/or acceleration then observed their response to Sea Lamprey attack in a lab setting. We determined the top predictor variables to be included in predictive models using a methodology based on optimal model fit and the fewest number of variables. In general, these included variables related to roll, pitch, and heart rate. The top four variables were selected to produce models using random forests fit with 1000 trees using training datasets. The generated models proved to be effective at predicting Sea Lamprey attachment in test datasets. Specifics related to model accuracy will be discussed. The application of these models in future deployments of tagged Lake Trout could yield the first field-based estimates of Sea-Lamprey attack rates and attack lethality in Lake Trout.

Saturday March 11th, 11:20
Talk 5: *Exploring the impact of juvenile fish exclusion on the sampling efficiency of larval light traps.*

Jennifer R. Powell*[1], Alex Van Nynattan, Madeline Morrison, and Nicholas E. Mandrak[1]Fish Ecology and Conservation Physiology Laboratory, Department of Biology and Institute of Environmental and Interdisciplinary Science, Carleton University
[1]Department of Physical and Environmental Sciences, University of Toronto Scarborough
[2]Department of Biological Sciences, University of Toronto Scarborough
***Presenting Author**

Larval light traps can be effective at sampling larvae, but are not without their challenges. While using quatrefoil light traps to sample for larvae of rare species in the spring and summer of 2022 in southwestern Ontario, capture of larvae was poor, particularly in traps with large numbers of juvenile centrarchids. It was hypothesized that juvenile presence may reduce overall larval collections through several possible mechanisms including direct predation, resource consumption, or avoidance of the larger fishes by larvae. An exclusion study was conducted using chicken wire or a 1 x 1 cm square mesh to examine if juvenile

centrarchids could be effectively excluded from the light traps and if juvenile presence impacted food resources within the traps. The chicken-wire traps had double the abundance of juvenile fishes compared to the control and square mesh traps, which had approximately equal abundance. However, the size of the fishes was significantly different between the treatments, with the control traps having the largest fishes and the square mesh the smallest. The effect of juvenile fish presence on macroinvertebrate abundance in the traps will also be presented.

Saturday March 11th, 11:40
Talk 6: *Classifying agricultural drains using fish communities: Comparison of conventional and eDNA methods.*

Markelle E Morphet* and Nicholas E Mandrak
Department of Biological Sciences, University of Toronto Scarborough
***Presenting Author**

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

Saturday March 11th, 1:00
Talk 7: *Bighead Carp overwintering under climate change – spawning, survival, and implications for invasion.*

Erik K Dean[1], D. Andrew R. Drake[2], Nicholas E. Mandrak[1,3]
[1]University of Toronto Scarborough, Physical and Environmental Sciences,
[2]Fisheries and Oceans Canada,
[3]University of Toronto Scarborough, Biological Sciences
***Presenting Author**

Bighead Carp threatens to expand northward and invade the Laurentian Great Lakes, but there is uncertainty about whether the winter conditions encountered there could impose a population bottleneck. Population growth of Bighead Carp is highly sensitive to the survival of young-of-year (age-0), but this life stage is often implicated in population bottlenecks at northern latitudes. The reduced size and capacity to store energy makes young-of-year particularly vulnerable to overwinter starvation. By modelling how spawn timing, growth, and the onset and duration of winter could be affected by climate warming, we explored how the recruitment and overwinter survival of young-of-year Bighead Carp could change in response to climate change. Given that young-of-year are highly influential to population performance, increases in temperature that help them overcome overwinter starvation could contribute significantly to changes in the overall risk of invasion. Our results suggest that anticipated warming could increase overwinter survival primarily by enabling young-of-year to grow larger before the onset of winter and, to a lesser extent, by reducing the extent of overwinter starvation. Accordingly, projected warming conditions could enable populations to establish farther north than previously possible by mid-century.

Saturday March 11th, 1:20
Talk 8: *A Fish out of winter: Winter energy acquisition and storage influence spring reproduction in a warm-water fish.*

Timothy Fernandes*[1], Brian Shuter[2,3], Bailey McMeans[1]
[1]University of Toronto Mississauga, Department of Biology
[2]University of Toronto, Department of Ecology and Evolutionary Biology
[3]Ontario Ministry of Natural Resources and Forestry, Aquatic Research and Development Section
***Presenting Author**

Winter at northern latitudes is thought to represent a period of physiological inefficiency and resource limitation in resident warm-water fishes. As a result, seasonal patterns of energy allocation observed in these species appear to be largely shaped by the severity and length of winter conditions. However, recent evidence points to longer winters as a critical component of reproductive cuing and allocation. Here, we compare winter energy dynamics in a spring-spawning, warm-water fish across populations to investigate the influence of winter energy stores and consumed energy on reproductive preparation and allocation. We discuss the role of diet and parasite load in potentially shaping winter energy depletion and reproductive potential.

Saturday March 11th, 1:40
Talk 9: *Toward area-based effort for boat electrofishing in the Toronto Region: An accidental experiment.*

Rick Portiss, Angela Wallace, Brian Graham, Matthew Fraschetti*
Toronto and Region Conservation Authority
***Presenting Author**

Toronto and Region Conservation Authority conducts electrofishing surveys through spring, summer and fall to sample the fish communities within the Toronto Region. Our 21ft electrofishing boat is equipped with a Smith-Root Apex Control Box, the Apex unit is what allows us to conduct our sampling. The unit has an internal GPS which tracks our location as we move along our sampling transect and records all other electrofishing data. We want to look at our sampling method, standardized 1000 second runs, and see if we are consistently completing the same distance for each sample. There are many factors that effect our consistency such as the operator, weather, and waves. Would moving to an area based approach result in more consistent and more accurate data? That is the question this presentation aims to answer.

Saturday March 11th, 2:00
Talk 10: *Changes in the freshwater fish fauna of Canada since 1973.*

Dr. Nicholas E. Mandrak
Department of Biological Sciences, University of Toronto Scarborough, Toronto, ON M1C 1A4

Currently, there are 201 freshwater fish species known to be native to Canada and 21 species not native to Canada known to be introduced and established. This includes species that spend all, or a substantial portion of, their lives in fresh waters. Prior to the publication of the definitive Freshwater Fishes of Canada in 1973, comprehensive checklists of freshwater fishes in Canada listed 44 species in 1700, 72 species in 1836, 63 species in 1897, 145 species in 1907, 228 species in 1913, 177 species in 1947, 187 species in 1958, 186 species in 1967, and 183 species in 1969. These changes were the result initially of the increasing frequency and geography of surveys and, subsequently, of taxonomic revisions of our native fauna and establishment of non-native species. Freshwater Fishes of Canada listed 177 native and four non-native species. Since then, 17 additional non-native species have become established), and 25 native species have been "gained". Of the "gained" native species, seven species were result of taxonomic splits of one species into two species, six were rare with a limited range and only collected since 1973, five were previously confused with other native species, five were the result of populations elevated to full species status, and one species (extirpated Paddlefish) was not included in Freshwater Fishes of Canada. Some, but not all of these changes are included in the recently revised ROM Field Guide to the Freshwater Fishes of Ontario, as the latest Common and Scientific Names

of Fishes from the United States, Canada, and Mexico book has just been finalized. Be prepared for some significant names changes!

Sunday March 12th, 08:40
Keynote: *Molecular biomonitoring with DNA barcodes and environmental DNA.*

Dr. Robert Hanner
Department of Integrative Biology, University of Guelph

Fisheries biomonitoring can be time consuming, expensive and imprecise using conventional methods. Recent advances in molecular biology can augment existing tools for fish identification and detection. Expanding DNA reference sequence libraries for fishes are facilitating the accurate identification of eggs, larvae and fragmentary remains that are otherwise difficult to identify morphologically. They can also be used to identify traces of DNA that fishes shed in the aquatic environment using targeted (e.g. taxon specific) or passive community based methods. Through a variety of case studies we will explore the potential utility of these methods for monitoring Invasive Alien Species, Species-at-Risk and Valued Ecosystem Component Species in Ontario.

Sunday March 12th, 09:20
Talk 12: *An aquatic species at risk threat assessment and prioritization exercise for the Lower Thames Valley Conservation Authority watershed.*

Sarah E. Walton-Rabideau, Vicki L. McKay* and Neil Pothier
Lower Thames Valley Conservation Authority (LTVCA)
***Presenting Author**

The Lower Thames Valley Conservation Authority undertook a two-year aquatic species at risk (SAR) threat assessment to better understand how a suite of environmental factors and stressors may impact 18 fish and 15 mussel SAR inhabiting the region's 58 subwatersheds and their critical habitats. Threats reviewed revolved around biology, soils, ecosystem modifications, climate change, water quantity, drainage and connectivity, groundwater, urban development and water quality. Results indicate that land use is dominated by agricultural activities with more than 95% of wetlands drained for these purposes. Indeed, three subwatersheds that drain into Lake St. Clair have experienced more than 99% wetland loss while only 10% of their watercourses are sheltered by healthy riparian zones. Sensitive species inhabit more than 50% of open drains rated, and, while flood protection structures are known to impede migration and cause fish mortality, the extent of their impact on fish SAR in the watershed is presently unknown. Water quality results reflect broader issues across the watershed. Improvements are required particularly with respect to

chloride, heavy metals (i.e., copper) and pesticides. The health of nearly 85% of watercourses, based on the assessment of benthic samples, ranged from "fairly poor" to "very poor". In addition, several areas experienced chronic road salt exposure during summer months. Although the watershed was identified as having a low risk of coliform contamination, this failed to identify that not all cattle have been excluded from watercourses. Thematically identifying natural asset vulnerability to climate change may enable staff to reach out to applicable landowners to incentivize stewardship initiatives. Terrestrial ecosystem complexes were rated extremely vulnerable, including critical habitat for Rondeau Bay's diverse aquatic SAR community. Projected bioclimatic shifts suggest an increase in growing-degree days, which may lead to an increase in pesticide usage and reduced survival of aquatic SAR amidst cumulative physiological stressors. Threat information was enumerated and used to rank those subwatersheds containing at least one SAR. Threats selected for the prioritization exercise could be physically managed or mitigated through stewardship activities. These included soil erosion rates, turbidity levels, percent riparian shading, proportion of water quality samples exceeding provincial guidelines, calculated risk of water contamination and benthic indices. Eleven subwatersheds were ranked as priority using four approaches based on data availability. Those ranked based on sheer size indicated restoration efforts were needed in the western end of the watershed, while prioritization based on a per hectare basis shifted the focus to subwatersheds in the east. Focusing restoration efforts on these 11 priority subwatersheds allows the LTVCA to direct limited SAR funding to targeted projects in areas most likely to benefit aquatic SAR recovery.

Sunday March 12th, 09:40
Talk 13: *Consequences and mechanisms of intraspecific ecological divergence along the benthic-pelagic axis in Arctic Charr (Salvelinus alpinus)*

Sarah Steele
Arctic Charr Research Group, University of Iceland

Evolutionary divergence along the benthic-pelagic axis occurs repeatedly among fishes and is associated with consistent divergence in body elongation, fin adaptations, and craniofacial responses, among others, for habitat and prey specialization. Divergence along the benthic-pelagic axis is common among closely related species, resulting in immense trait diversity within a lineage. However, divergence within species is also common in marine and freshwater fishes, and serves as a window into the process of speciation. Arctic Charr (*Salvelinus alpinus*) is a widespread, highly plastic, and polymorphic organism displaying significant diversity in body size, morphology, diet, life history, and behaviour throughout its range. Following the arrival of Arctic Charr in Iceland

approximately 10,000 years ago, anadromous charr radiated into a variety of morphological forms, ecological roles, and habitats. Elevated plasticity may have enabled rapid evolution in response to novel inland environments and prey resources. Investigating divergence of multiple traits in wild-caught and lab-reared individuals of Icelandic Arctic Charr, I attempt to unravel the mechanisms underlying divergence along the benthic-pelagic axis in fishes. To investigate the functional morphology and impact of prey specialization during divergence of Arctic Charr along the benthic-pelagic axis, cranial morphology was studied in wild-caught adults of four sympatric charr morphs of Lake Þingvallavatn. Clear bone shape divergence along a benthic–pelagic axis was found in several bones (dentary, articular-angular, premaxilla and maxilla), as well as allometric differences between morphs in the dentary. Trait divergence can be experimentally induced, allowing the study of plasticity within and across morphs in response to environmental stimuli. Using a common-garden rearing experiment, morphological response to benthic and pelagic diet treatments within and across morphs was assessed, investigating divergence of developmental plasticity of specialized morphs from anadromous populations and the impact of hybridization on plasticity. Results from growth and head morphology show strong morphological divergence across morphs and diet treatments. We find high correspondence of morphological change in response to diet type across genotypes that follows evolutionary divergence of specialized morphs. Using the same individuals, impacts of divergent feeding on brain development and behaviour were also assessed. Finally, I outline ongoing research on the development origins of morphological features associated with divergence along the benthic-pelagic axis as well as implications for conservation and fisheries management.

Sunday March 12th, 10:20
Talk 14: *Validation of non-lethal sampling methods in freshwater fishes.*

Laura Haniford*, Steven Cooke
Fish Ecology and Conservation Physiology Laboratory, Department of Biology and Institute of Environmental and Interdisciplinary Science, Carleton University, 1125 Colonel By Dr., Ottawa, ON, K1S 5B6, Canada

Traditional sampling methods for fish species require lethal sampling to assess health, contaminant burden, or pathogen load. However, lethal sampling may be detrimental to vulnerable fish the populations (species at risk, rare species or species with long life histories or late sexual maturity. Non-lethal sampling methods are commonly used, but their impact on fish is not well understood. Here, behaviour and survival were assessed to evaluate any potential impacts of non-lethal sampling in three freshwater fish species (Smallmouth Bass, Walleye, and Lake Trout). Fish were sampled using either blood, gill or muscle biopsy, or

a combined treatment of all three methods. Results indicate that a single biopsy has no significant impact, but the combinative treatment resulted in lower activity levels and a higher mortality rate when compared to control or single biopsy fish, indicating that the stress of combined biopsy negatively impacted their survival and spawning.

Sunday March 12th, 10:40
Talk 15: *Why care about fish movements and why do they matter to fish and ecosystems.*

Gary Whelan
Michigan DNR Fisheries Division, Lansing, Michigan

A lot of emphasis has been put on examining fish movements in the last decade as it is really interesting science to both ecologists and the public. This emphasis is further in the spotlight with the huge amounts of U.S. and Canadian federal, state, and provincial funding currently being directed to resolving connectivity issues. Thus, it is critical to consider and understand why fish movements are critical to ecosystems to ensure that decision makers are fully informed of the importance of this system process and continue to assist in re-connecting our fragmented aquatic systems. Fish movements are important on every spatial and organizational scale from individual fish completing their life histories to the movement of energy through watersheds to sustaining balance in large ecosystems. This paper will summarize the existing literature at each of these scales to provide this context to this key issue facing the U.S. and Canada, and will frame the rationale on why fish movement is a critical system process that matters to ecosystem functioning, biodiversity sustainability, and to human observers.

Poster Presentation Abstracts

Lake Embayment Impacts on Northern Ontario Smallmouth Bass Distribution
Alan Bui *(Student Presentation)*
University of Toronto, Ecology and Evolutionary Biology

Temperature is a critical limiting factor for many species, particularly Smallmouth Bass which must rely on their environment to maintain a healthy internal body temperature. Drastic temperature changes can therefore have a significant impact on life history traits such as reproduction and growth. This can further scale up to impacts on population and community composition. With steadily rising annual temperatures, Smallmouth Bass in Ontario are facing potential extinction and habitat destruction. As a response, their distribution ranges are showing shifts towards Northern Ontario, placing potential habitats at increased risk of invasive species. The introduction of this non-native predator is notably catastrophic as smaller native fishes are particularly vulnerable and can be forced into more complex, unfamiliar habitats or experience a significant reduction in activity (such as feeding and movement), growth, and reproduction. Smallmouth Bass occurrence is heavily tied to young-of-year survival which in turn is heavily impacted by water temperature. Determining optimal thermal habitats for bass growth is therefore crucial in protecting aquatic biodiversity. Abiotic factors, such as climate, are well documented to have a more pronounced influence in dictating water temperature. However, lake shape has not been as extensively researched, particularly the role of lake embayments. Lake embayments are small pockets of water along the lake's perimeter and can be visualized as smaller lakes attached to a larger main body. Due to the smaller surface areas, embayments are likely to experience warmer peak water temperatures compared to the main body, much like how a smaller lake would compare to a larger one. Warming and cooling are also likely to occur earlier in the spring and autumn, respectively.

This project will examine how embayments in complexed-shaped lakes may be able to provide a refuge for warm-water species, such as Smallmouth Bass, to move into during colder periods and promote more efficient growth compared to regularly shaped lakes. Water temperature regimes will be simulated for a variety of different-sized and shaped theoretical lakes using climate and water quality data from current lakes along the northern limit of Smallmouth Bass distribution in Ontario. The temperature regimes are then used in a bioenergetics model to estimate the growth of young-of-year bass and predict their survivability in each of the different lakes. Lakes along the northern limit with and without recorded instances of Smallmouth Bass will also be paired for an empirical analysis of lake morphology. Preliminary results have shown that there

is a considerable difference in temperature regimes and a This project hopes to illuminate the role of lake shape on water temperature and demonstrate a potential new avenue for determining which habitats are most at risk of invasive aquatic species.

Evaluating the efficacy of an intervention on reducing Catostomus sucker hybridization *(Student Presentation)*

Jillian N. Campbell[1], Zachary Hooley-Underwood[2], Elizabeth G. Mandeville[1]
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Non-native species are a leading threat to fish biodiversity. They pose risks to native populations through competition, predation, disease, and hybridization. Following human-mediated introductions of non-native species, native and non-native species can hybridize to the detriment of the imperiled native species. *Catostomus* fishes in the Upper Colorado River Basin are an example of this. Recent evidence has shown extensive hybridization between non-native White Sucker (*C. commersonii*) and native Flannelmouth and Bluehead Sucker (*C. latipinnis* and *C. discobolus*). This system provides a suitable model for testing the efficacy of an intervention to reduce the abundance of non-native species and their hybrids. This study implements a Resistance Board Weir (RBW) as a fish barrier across Roubideau Creek, a tributary of the Gunnison River in Colorado (USA), to restrict non-native fish access to spawning habitat. Conducted over four years, the study gathers genetic data from larval fish samples, pre- and post-implementation of the RBW. Genetic evidence allows us to determine the efficacy of a RBW at controlling non-native species access to spawning locations. In addition, geographic data collected alongside larval fish allows for analysis of spatial spawning preferences in both the native and non-native sucker fish. Combined this information can help provide the most accurate recommendations regarding conservation and management interventions going forward. We captured a subset of spawning adults and their progeny (larval fish) in 2019 through 2022 and used tissue samples to extract DNA and generate high resolution genomic data. Preliminary analyses of genomic data show that hybridization was extensive in this region pre-implementation of the Resistance Board Weir in 2021. We expect that the abundance of White Suckers and their hybrids will decrease significantly during years of controlled access. Additionally, it is expected that native larval fish will be found in a higher abundance upstream, compared to non-native and hybrid larval fish, consistent with current field observations in this system as well as with other similar studies. This work will contribute novel information to understanding how effectively conservation efforts using fish barriers can reduce non-native species and prevent hybridization.

Hybridization among Ontario leuciscid minnow species in anthropogenically disturbed environments *(Student Presentation)*

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Aquatic habitats have been disproportionately impacted by anthropogenic disturbances including deforestation, sedimentation, eutrophication, and pollution. These anthropogenic disturbances can disrupt ecosystems and alter species population dynamics; disturbed environments, including agriculturalized or urbanized areas, may accommodate increased hybridization, which could lead to a loss of biodiversity. Interspecific hybridization is common between genetically related organisms, especially once reproductive barriers, such as spatial or behavioural isolation, have been altered or removed. In this project, we will assess how outcomes of hybridization vary between minnow species and how the type of disturbance affects the frequency and type of hybrid individuals. After quantifying hybridization between species, we will examine how these patterns relate to anthropogenic disturbance, as defined by land use characteristics and other spatial predictors. We will generate genome-wide, reduced-representation sequencing data and align it to my recently assembled reference genome. Our specific focal taxa include creek chub (*Semotilus atromaculatus*) and their hybrids with 8 related Leuciscidae fish species, totaling more than 1200 individuals, caught across 27 sampling sites. This research is an opportunity to learn how human activities have shaped the evolution of native species in Southern Ontario, particularly those of traditionally low economic value.

Demographic history of cyprinid minnow species in anthropogenically disturbed environments *(Student Presentation)*

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Southern Ontario has experienced four centuries of intensive European-style and contemporary anthropogenic land use, and millennia of Indigenous land use. Land use in a stream watershed and modifications of streams for human use disturb stream habitat and impact fish populations. Shifts in population dynamics, such as population splits, size changes, admixture, and migration, are influenced by disturbance. Demographic inference methods that use genetic data can provide insight into historical population dynamics using the genomes of modern individuals. By modelling the demographic history of cyprinid minnows within the last 1000 years, we aim to provide further insight into how historical disturbances shape modern population genetic trends in fish. We have captured

870 fish representing seven species from 25 waterways across Southern Ontario and two in Algonquin Provincial Park, encompassing a range of anthropogenic disturbance histories, including agriculture, urbanization, and logging. Using high resolution genomic data, we will compare demographic histories across locations and across species with different tolerances for disturbance. The results of this work will broaden our understanding of how disturbance affects fish biodiversity and how historical disturbance can shape modern fish populations, as well as revealing how development in southern Ontario has shifted fish population dynamics.

The syntenic relationship between the first high-quality chromosome level Northern Redbelly Dace (*Chrosomus eos*) genome and the Zebrafish (*Danio rerio*).

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The Northern Redbelly Dace (*Chrosomus eos*) and its sister taxon, the Finescale Dace (*Chrosomus neogaeus*) formed an ancient hybrid lineage during the last glacial maximum that has been a subject of curiosity owing to its unisexual gynogenetic nature. Hybrids are all female and reproduce without incorporating male genetic material. Both parental species and the hybrid lineage are common across Ontario, and northeastern North America. Studies investigating the genomic history of this hybridization event have focused on the minimal evidence of contemporary hybridization and some potential outcomes of periodic incorporation of spermatic material, generally utilizing small microsatellite markers. To deepen our understanding of the potential genomic mechanisms for this unusual hybridization event, we present the first high-quality, chromosome level whole genome for *Chrosomus eos*, and assess its quality and composition for use in future studies. A brief analysis on the syntenic relationship between the *Chrosomus eos* genome and the distantly related cyprinid Zebrafish (*Danio rerio*) genome show a degree of conservation on each of the 25 chromosomes. This genome will serve as an excellent resource for future avenues of study regarding *Chrosomus eos* and its unique hybridization complex and may enable genomic analysis of other related fish species. We will use this genome to assess the potential for contemporary hybridization that may occur as a result of anthropogenic disturbance and global climate change.

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