Proceedings of the 2023 Canadian Freshwater Mollusc Research Meeting: November 15-16, 2023, Burlington, Ontario

Editors: Todd J. Morris, Mandy P. Gibson, Scott M. Reid and Kelly A. McNichols-O'Rourke

Fisheries and Oceans Canada
Great Lakes Laboratory for Fisheries and Aquatic Sciences
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Les rapports techniques contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui ne sont pas normalement appropriés pour la publication dans un journal scientifique. Les rapports techniques sont destinés essentiellement à un public international et ils sont distribués à cet échelon. II n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques de Pêches et Océans Canada, c'est-à-dire les sciences halieutiques et aquatiques.

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Les numéros 1 à 456 de cette série ont été publiés à titre de Rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de Rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de Rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925.

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ABSTRACT

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The fifth biennial Canadian Freshwater Mollusc Research Meeting was held at the Canada Centre for Inland Waters in Burlington, Ontario on November 15–16, 2023. The meeting was jointly hosted by Fisheries and Oceans Canada and the Ontario Ministry of Natural Resources and Forestry. Sponsors for the event included the St. Clair Region Conservation Authority and the Healthy Headwaters Lab at the University of Windsor. The research meeting included 30 platform presentations and 11 posters. This year's hybrid meeting saw participation from the largest group ever, with 85 in-person attendees and another 55 groups online for the two-day gathering.

The objective of this meeting was to bring together Canadian malacologists to share past, current, and ongoing research on freshwater molluscs. Topics of discussion included: distribution and sampling, ecotoxicology, threats and limiting factors, mitigation and recovery actions, and biology and ecology of freshwater molluscs. Attendees from six Canadian provinces (BC, ON, NB, NS, QC, SK) and five American states (NY, MI, MN, MT, OK) represented federal departments, provincial/state agencies, first nations, academic institutions, environmental consultants, non-governmental organizations, naturalist groups, zoos, museums, and interested citizens. The emphasis of this meeting was to build relationships and promote future collaborations and research opportunities.

RÉSUMÉ

Morris, T.J., Gibson, M.P., Reid, S.M. and McNichols-O'Rourke, K.A. (Editors). 2024. Proceedings of the 2023 Canadian Freshwater Mollusc Research Meeting: November 15–16, 2023, Burlington, Ontario. Can. Tech. Rep. Fish. Aquat. Sci. 3612: viii + 52 p.

La cinquième réunion biennale de recherche sur les mollusques d'eau douce du Canada a eu lieu les 15 et 16 novembre 2023 au Centre canadien des eaux intérieures à Burlington, Ontario. Elle était organisée conjointement par Pêches et Océans Canada et le ministère des Richesses naturelles et des Forêts de l'Ontario. Les commanditaires de l'événement comprenaient l'Office de protection de la nature de la région de St. Clair et le laboratoire Healthy Headwaters de l'Université de Windsor. On y comptait 30 présentations orales et 11 affiches exposées. Le taux de participation à cet événement hybride de deux jours était à son plus élevé; il y avait 85 participants en personne et 55 groupes de participants en ligne.

L'objectif de cette réunion était de rassembler les malacologistes canadiens afin qu'ils puissent échanger sur la recherche passée, actuelle et en cours portant sur les mollusques d'eau douce. Les sujets de discussion abordés comprenaient : la répartition et l'échantillonnage, l'écotoxicologie, les menaces et les facteurs limitatifs, les mesures d'atténuation et de rétablissement, et la biologie et l'écologie des mollusques d'eau douce. Les participants, provenant de six provinces canadiennes (Colombie-Britannique, Ontario, Nouveau-Brunwick, Nouvelle-Écosse, Québec, Saskatchewan) et de cinq états américains (New York, Michigan, Minnesota, Montana, Oklahoma), représentaient des ministères fédéraux, des organismes provinciaux et d'État, des Premières Nations, des établissements universitaires, des consultants en environnement, des organisations non gouvernementales, des groupes de naturalistes, des zoos, des musées et des citoyens intéressés par le sujet. La réunion était axée sur l'établissement de relations et la promotion de futures collaborations et possibilités de recherche.

EDITORS' COMMENTS

These proceedings contain all of the abstracts that were presented at the research meeting. The abstracts were reviewed in a limited capacity and formatted by the editors. Questions or comments relating to their content should be directed to the authors of each abstract and not to the editors. The views and statements contained in these proceedings are those of the presenters and are neither condoned nor rejected by the editors. Any use of trade names or products does not constitute endorsement or recommendation for use.

REMARQUES DES ÉDITEURS

Le présent compte rendu contient tous les résumés ayant été présentés lors de la réunion de recherche. Les résumés ont été révisés en partie et formatés par les éditeurs. Les questions ou les commentaires liés à leur contenu devraient être envoyés aux auteurs de chaque résumé et non aux éditeurs. Les points de vue et les affirmations exprimés dans ces comptes rendus sont ceux des conférenciers et n'ont été ni approuvés, ni infirmés par les éditeurs. L'utilisation d'une marque de commerce ou d'un produit ne constitue nullement une forme d'approbation ou de recommandation de son utilisation.

ACKNOWLEDGEMENTS

The organizers would like thank all presenters and attendees for making this research meeting successful. A special thanks goes to our supporting partners - Healthy Headwaters Laboratory at the University of Windsor and the St. Clair Region Conservation Authority. We thank the Green Café for providing hospitality services over the two-day meeting. Thanks goes to Jessica Epp-Martindale and Julia Colm for technical support and all those who helped with clean up at the end of the meeting.

CANADIAN FRESHWATER MOLLUSC RESEARCH MEETING

November 15–16, 2023

Canada Centre for Inland Waters

CANADIAN FRESHWATER MOLLUSC RESEARCH MEETING ORGANIZING COMMITTEE

Dr. Todd J. Morris	Fisheries and Oceans Canada
Kelly McNichols-O'Rourke	Fisheries and Oceans Canada
Mandy Gibson	Fisheries and Oceans Canada
Dr. Scott M. Reid	Ontario Ministry of Natural Resources and Forestry

SUPPORTING PARTNERS

Healthy Headwaters Laboratory, Great Lakes Institute for Environmental Research, University of Windsor, Canada

THE HEALTHY HEADWATERS LAB
Great Lakes Institute for Environmental Research
University of Windsor, Canada

St. Clair Region Conservation Authority, Strathroy, Ontario, Canada

St. Clair Conservation

Program Schedule
Wednesday November 15, 2023
All times are in Eastern Standard Time (EST)

8:15 – 8:45	Registration and Poster set-up Introductions and welcoming address	
8:45 – 9:00	Introductions and welcoming address	
Session 1: Distribution and Sampling		
9:00 – 9:20	Platform 1 (Virtual)	Diverse gastropod assemblages in two large rivers of the Laurentian Great Lakes (virtual) **Shay S. Keretz, Nichelle M. VanTassel**, Daelyn A. Woolnough, Dylan T. Powell, Gabrielle Sanfilippo, Aaliyah Wright, Todd J. Morris, Ashley K. Elgin, Edward F. Roseman, and David T. Zanatta
9:20 – 9:40	Platform 2 (Virtual)	Benthic macroinvertebrate and freshwater mussel associations in the Lower Qu'Appelle River. **Iain D. Phillips**
9:40 – 10:00	Platform 3 (Hybrid)	Research on the Hickorynut mussel–Lake Sturgeon interaction and their preferential habitats in the fluvial St. Lawrence River and its tributaries, including the Ottawa River **André L Martel**, **Hans-Frédéric Ellefsen**, Katriina Ilves, **Annie Paquet**, Noel Alfonso, Marie-Hélène Fraser, Ben Aubrey, Jill Heinerth, Simon Jacques, Mark D'Aguiar, Laélien Bassi, Colin Rennie, and Tim Haxton
10:00 –10:20	Platform 4	Mollusk Mysteries: The Search for the Eastern Pondmussel (*Sagittunio nasutus*) in the Rouge Marsh (Toronto, ON) **Donnell Gasbarrini** and Mary-Kate Whibbs
10:20 – 10:40	BREAK	

10:40 – 11:00	Platform 5	Expanding our knowledge of freshwater mussel species occurrence and distribution across Toronto and Region Conservation Authority's jurisdiction **Rebecca Dolson**, David Lawrie, and Jonathan Ruppert
11:00 – 11:20	Platform 6	Conservation status of *Toxolasma parvum* (Lilliput) in Canada **Mandy Gibson**, Kelly McNichols-O'Rourke, and Todd J. Morris
11:20 – 11:40	Platform 7	A comparison of freshwater mussel species detection and abundance across different survey methods **Hunter M. Torolski**, James M. Long, Robert Lonsinger, and Lindsey Bruckerhoff
11:40 – 12:00	Platform 8	Update on mussel brail sampling in non-wadeable habitats along southwestern Ontario rivers **Scott M. Reid,** Anita LeBaron and Emily Hassal
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13:20 – 13:40	Platform 10	Assessing toxicity and bioconcentration of the pharmaceutical Atovaquone in unionid mussels Patricia L. Gillis, **Erika A. Burton**, Naomi Stock, Danielle. Milani, Shirley Anne Smyth, Joseph Salerno, Shelby Robertson, James C Bennet, and Steve Teslic
13:40 – 14:00	Platform 11	Multiple stressors in microplates: adapting standard ecotoxicity methods for mixture tests

		Rachel K. Giles, Elli Hung, Patty Gillis, Chris Barnhart, and Chelsea Rochman
14:00 – 14:20	Platform 12	Minding the (data) gap: Development of toxicity test methods with often-overlooked freshwater snails **Ève A.M. Gilroy**, David W. McNabney, Karyn B. Robichaud, Kallie Shires, Shelby A. Ravary, Dasha L. MacKay, Victor Pham-Ho, Ashley C. Ferns, and Maria Villella
14:20 – 14:40	Platform 13	Assessing the toxicity of recreational lead fishing gear in the freshwater snail *Planorbella pilsbryi* **David W.G. McNabney**, Ève A.M. Gilroy, Kallie Shires, Shelby A. Ravary, Ashley C. Ferns, Erin M. Leonard, Jason Miller, Sabrina St Hilaire, Natalie Nykamp, Sheena L. Campbell, Heather Jovanovic, Amy Sett, Rick A. Frank, and Gerald Tetreault
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15:20 – 15:40	Platform 15	Microplastics in freshwater bivalves chronically exposed to wastewater effluent in the Grand River, Ontario **Emily Robson**, Evlyn Sun, Karen Kidd, Patricia Gillis, Jim Bennett, Joe Salerno, and Ryan Prosser
15:40 – 16:00	Platform 16 (Virtual)	The impacts of zebra mussels (*Dreissena polymorpha*) on native freshwater unionid mussels in Lake Memphrémagog, QC (virtual) **Brielle Comartin,** Annick Drouin, and Anthony Ricciardi
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Program Schedule
Thursday, November 16, 2023
All times are in Eastern Standard Time (EST)

Session 3: Threats and Limiting Factors (continued)		
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9:20 – 9:40	Platform 18	Evaluating ecohydraulic trade-offs due to positioning in freshwater mussels in rivers **Emile Sabeti-Mehr** and Josef D. Ackerman
9:40 – 10:00	Platform 19	The effect of total nitrogen (NH_4^+ , NO_3^- , and NO_2^-) flux on nutrient cycling in a freshwater mussel (*Lampsilis siliquoidea*, Fatmucket) **Sydney A. Todd** and Josef D. Ackerman
10:00 – 10:20	Platform 20	An aquatic species at risk threat assessment and prioritization exercise for the Lower Thames Valley Conservation Authority watershed **Vicki L. McKay,** Sarah E. Walton-Rabideau and Neil Pothier
10:20-10:40	BREAK	
10:40 – 11:00	Platform 21	The forgotten mussel, a consultant's perspective **Victoria Tousaw** and Brad Dufour
11:00 – 11:20	Platform 22	A dangerous shell game: diving into the history of commercial freshwater mussel harvests in Canada **Catriona Hayes Morris** and **Todd J. Morris**

Session 4: Mitigation and Recovery Actions		
11:20 – 11:40	Platform 23 (Virtual)	The effect of riparian vegetation buffers on unionid mussel habitats **Al Lu**, Todd J. Morris, and Josef D. Ackerman
11:40 – 12:00	Platform 24	Approaches and challenges in executing a large-scale mussel relocation effort on the Wisconsin River **Meghan Martinski**, Blair Kimble, Ryan Holem, and Eric Englund
12:00-13:00	LUNCH	
Session 4: Mitigation and Recovery Actions (continued)		
13:00 – 13:20	Platform 25	Evaluating the effects of translocations on freshwater mussel communities as a conservation mitigation tool **Lauren Damphousse**, Todd J. Morris and Catherine Febria
13:20 – 13:40	Platform 26	Harmonization of datasets among and within organizations accelerate efforts to save at-risk unionids in the Sydenham River watershed **Julia A. Willsie**, Alice Grgicak-Mannion, Todd Morris, and Catherine M. Febria
13:40 – 14:00	Platform 27 (Virtual)	Highly variable populations of endangered Snuffbox across Michigan: How the focus on Snuffbox may help unionid conservation **Daelyn A. Woolnough** and Scott M. LaValley
14:00 – 14:20	BREAK	
Session 5: Biology and Ecology of Freshwater Molluscs		

14:20 - 14:40	Platform 28	Identifying environmental drivers of shell shape variation in the freshwater gastropod *Campeloma decisum* Lauren Western and **David Zanatta**
14:40 – 15:00	Platform 29	Microbead models of larval and juvenile mussels go with the flow: Dispersal in reaches with different hydrodynamic conditions **Christopher R. Farrow**, Loong-Tak Lim, and Josef D. Ackerman
15:00 – 15:20	Platform 30	Temporal dynamics of the host-parasite relationship in freshwater mussels: An attempt to partition hosts **Stephanie L. Smodis**, Todd J. Morris, and Josef D. Ackerman

Poster Session
Wednesday, November 15, 2023
All times are in Eastern Standard Time (EST)
16:00 – 17:00

Poster 1	Exploring the fish-mussel connection in a Canadian context **Ben Aubrey**, André L. Martel, Sarah E. Steele, Steven J. Cooke, and Katriina L. Ilves
Poster 2	Assessing the influence of small dams/riverine infrastructure on freshwater unionid species-at-risk population connectivity **Brianna Curtis** and Catherine Febria
Poster 3	Towards a better understanding of the biology and effects of natural seasonal patterns on endangered freshwater mussels through captive care Laurie Savard, Romy Léger-Daigle and **Hans-Frédéric Ellefsen**
Poster 4	Freshwater mussel (family Unionidae) propagation for restoration and water quality improvement in the Niagara River drainage **Jonah A. Fronk**, **Max S. Striedl**, Isabel Porto-Hannes, and Corey A. Krabbenhoft
Poster 5	Dietary exposure of stormwater contaminants in biofilm to *Neocloeon triangulifer* and *Planorbella pilsbryi* **Gab Izma**, Moira Ijzerman, Melanie Raby, Ryan Prosser, and Rebecca Rooney
Poster 6	Exploring the Upper St. Lawrence River and its tributaries for unionid mussels including the Eastern Pondmussel **Kate Schwartz**, Matthew Windle, Frederick W. Schueler, Emma Ehrenfeld, Elizabeth Hall, Elizabeth Grohmann, and Alisha Ng
Poster 7	Does stewardship improve stream habitats for unionid species at risk? A Sydenham River case study

	Thiranya Weerakoon and Catherine M. Febria
Poster 8	Declines in abundance of *Cipangopaludina chinensis* (Chinese Mystery Snail) **Frederick W. Schueler**, Aleta Karstad and Naomi Langlois-Anderson
Poster 9	Drawdowns of Doom: Bio(malaco) diversity impacts of water level management in impoundments **Frederick W. Schueler**
Poster 10	Into the deep - *Obovaria olivaria* (Hickorynut) in the Mississagi River **Kelly McNichols-O'Rourke**, Mandy Gibson, Keith Sayers, Ricki Lea Ferrigan, Anthony Chiblow, and Todd J. Morris
Poster 11	Patterns of shell shape variation in the critically imperiled freshwater mussel genus *Epioblasma* **James P. Haugh**, John M. Pfeiffer, and David T. Zanatta

Platform Presentation Abstracts

Platform 1: Diverse gastropod assemblages in two large rivers of the Laurentian Great Lakes (Virtual)

Shay S. Keretz[1], Nichelle M. VanTassel[1], Daelyn A. Woolnough[1], Dylan T. Powell[1], Gabrielle Sanfilippo[1], Aaliyah Wright[1], Todd J. Morris[2], Ashley K. Elgin[3], Edward F. Roseman[4], and David T. Zanatta[1]

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Freshwater gastropods are a highly diverse group of molluscs with > 70% of species listed as imperiled globally. To implement conservation and management strategies, there is an increased need to document gastropod assemblages. In the Laurentian Great Lakes, gastropod surveys have been sporadic both temporally and spatially, with most surveys focused on detection of invasive species. Therefore, to estimate gastropod densities in two large rivers of the Great Lakes, benthic surveys were conducted in the Detroit River (DR) in 2019 and the St. Clair River (SCR) in 2021. In all, 107 sites (n=56 DR sites and n=51 SCR sites) were surveyed for gastropods using a petite PONAR. All collected gastropods were identified minimally to family (and species when possible) and density was estimated by gastropod family for each site. Due to identification difficulty, Amnicolidae and Hydrobiidae specimens were combined into a single group, Amnicolidae-Hydrobiidae. In both DR and SCR, the families Pleuroceridae (37% and 56% total composition, respectively) and Amnicolidae-Hydrobiidae (42% and 22% total composition, respectively) contributed the most to overall gastropod composition. In DR, there was a mean (± SE) 321.3 ± 98.7 pleurocerids m^{-2} and a mean 362.0 ± 77.3 amnicolids-hydrobiids m^{-2}. In SCR, there was a mean 579.1 ± 128.3 pleurocerids m^{-2} and a mean 229.1 ± 47.2 amnicolid-hydrobiids m^{-2}. In addition to native snails, the invasive *Potamopyrgus antipodarum* (New Zealand Mudsnail) was identified at 4 (7%) DR sites and 10 (20%) SCR sites, with a mean 0.7 ± 0.3 individuals m^{-2} in the DR and 17.1 ± 13.5 individuals m^{-2} in the SCR. The detection of *P. antipodarum* represents its first documented occurrence in both rivers. These data, representing the first comprehensive gastropod surveys for these two large rivers, give insight into the diversity and abundance of these assemblages and establish an important baseline for these rivers.

Platform 2: Benthic macroinvertebrate and freshwater mussel associations in the Lower Qu'Appelle River (Virtual)

Iain D. Phillips

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Conservation of freshwater mussels is growing in importance due to global species declines, and the services they provide in filtration and sediment stabilization are crucial for water quality. Benthic macroinvertebrates are frequently used for ecosystem health classification, with management goals of conservation and biodiversity enhancement as well. Freshwater mussels often occur in dense beds, and they have the potential to affect the abundance of other macroinvertebrates in Saskatchewan rivers and streams. Interactions between these groups are not well understood in Saskatchewan and insights into the importance of one assemblage for the other will better inform management plans to accommodate both assemblages. I found benthic macroinvertebrate assemblages to have a weak negative relationship to mussel abundance in the Lower Qu'Appelle River. However, macroinvertebrate assemblage structure and abundance are primarily related to a turbidity gradient that increases with distance from an upstream reservoir. The distance from the upstream reservoir and associated increasing turbidity was not found to have a strong role in structuring the mussel assemblage or abundance in the Lower Qu'Appelle River. The instream conditions that define benthic macroinvertebrate assemblage structure are different than those that are important for mussels in the Lower Qu'Appelle River. The variables important for benthic macroinvertebrate assemblage structure are better established today, but the variables important in conserving mussel assemblages in this river are still not well understood.

Platform 3: Research on the Hickorynut mussel–Lake Sturgeon interaction and their preferential habitats in the fluvial St. Lawrence River and its tributaries, including the Ottawa River

André L. Martel[1], Hans-Frédéric Ellefsen[2], Katriina Ilves[1], **Annie Paquet[3]**, Noel Alfonso[1], Marie-Hélène Fraser[3], Ben Aubrey[1], Jill Heinerth[4], Simon Jacques[2], Mark D'Aguiar[2], Laélien Bassi[2], Colin Rennie[5], and Tim Haxton[6]

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[6]Ministry of Natural Resources and Forestry, ON.

Understanding the obligate connectivity between freshwater mussels and host fishes, which mussels require for metamorphosis and glochidia dispersal, is key to the conservation of Canada's 55 species of freshwater mussels (of which about 33% are at risk). This ongoing multidisciplinary research aims to improve our knowledge of the habitats, the benthic community and the relationship between fishes and native freshwater mussels of the St. Lawrence Lowlands and more specifically the fluvial St. Lawrence and its largest tributary, the Ottawa River, and in this way contributing to the conservation and recovery of some key species at risk. The two primary species of interest in this project are the Hickorynut (*Obovaria olivaria*) and the Lake Sturgeon (*Acipenser fulvescens*). Hickorynut are considered ''endangered'' by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and was added to the Schedule 1 of the *Species at Risk Act* in 2019. Lake Sturgeon in the study area are considered ''threatened'' by the COSEWIC and ''Susceptible'' under Québec's Threatened or *Vulnerable Species Act*.

The main objectives of this project are to: (1) validate the link between the Hickorynut and its presumed host fish, the Lake Sturgeon, and at the same time obtaining novel information on the connectivity between other local fishes and unionid mussels that share the same habitat as the Hickorynut and Lake Sturgeon, (2) obtain a more complete distributional map of the localities where the Hickorynut occurs along the St. Lawrence-Ottawa River system, (3) search for Hickorynut 'hot spots' and describe the characteristics of preferential habitats, including describing the abundance and distribution of the community of all unionid mussels, (4) examine the impact of stressors on Hickorynut populations with emphasis on invasive species (Dreissenidae). For objective 1 our teams are recording benthic images of a Hickorynut mussel bed with a permanent underwater video camera, as well as collecting fishes, including Lake Sturgeon, using experimental gill nets as well as seine nets, with the gills and fins of live

fish specimens examined in the field using hand lens. Live fishes with glochidia on their gills or fins are euthanized and preserved for further laboratory analysis and species identification. Glochidia are examined morphologically using high-resolution stereomicroscopes and a scanning electron microscope (SEM) to document and identify the species, identification validated using mtDNA. For objective 2, Hickorynut distribution is recorded by gathering information available from museum collections, research collections and through collaboration between governmental agencies, consultants, and amateur and professional malacologists involved in field surveys of riverways. For objective 3, preferential habitats of the Hickorynut are studied by examining the abundance of this species at localities identified as ‘hot spots’ using primarily the transect and quadrat (1m X 1m) method (occasionally the active time-search method), thus allowing quantitative comparisons of the abundance of Hickorynut in relation to that of other unionids in the community. Abundance is studied with SCUBA diving for the far-shore deepwater habitats as well as snorkeling for shallow water nearshore habitats. Transects of 25 to 100 m in length are used depending on environmental variables such as mussel density and safety factors during diving – e.g. visibility, which ranges from 0 to 5 m, current strength and tides (downstream sectors of the fluvial St. Laurence River). During transect surveys, all species of the unionid community living with the Hickorynut are identified and monitored. For objective 4, each unionid mussel is examined to determine whether or not invasive dreissenid mussels are present in the area or attached to the unionid shells. During this talk we will present some preliminary results for each of the four key objectives mentioned above, as well as upcoming field and laboratory work.

Platform 4: Mollusk Mysteries: The Search for the Eastern Pondmussel (*Sagittunio nasutus)* in the Rouge Marsh (Toronto, ON)

Donnell Gasbarrini[1] and Mary-Kate Whibbs[2]

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The Rouge Marsh is the most ecologically valuable habitat complex in the Scarborough region, providing important habitat for a wide diversity of species-at-risk, in addition to essential ecosystem services. Encompassed by the Rouge National Urban Park (RNUP), this complex lies adjacent to the largest urban center in Canada, discharges into Lake Ontario, and is subject to a wide range of ongoing anthropogenic stressors, including housing and recreation. Parks Canada established a Multi Action Species Plan (2021) to align with the *Species at Risk Act* (SARA) to provide protection for vulnerable species occurring within RNUP. Documented within the Marsh complex by the Ministry of Natural Resources and Forestry in 2012, the Eastern Pondmussel (*Sagittunio nasutus;* EPM) is listed as a Schedule 1 Species of Special Concern under the SARA. As a follow-up to the 2012 surveys, and in alignment with the RNUP Multispecies Action Plan, visual, tactile, and clam rake survey methods were employed at 12 sites within appropriate habitat in the complex in 2023. Timed searches with random start locations were conducted across four survey events in the Rouge Marsh, between 11 August and 29 September 2023 (inclusive). These surveys resulted in the capture of seven Giant Floater (*Pyganodon grandis*) and two Plain Pocketbook (*Lampsilis cardium*). These individuals were found sporadically throughout the complex. No evidence of EPM was observed, and appropriate EPM habitat within the Rouge Marsh Complex appeared to be minimal. As outlined in the Multi-Species Action Plan for RNUP, another round of surveys should take place in 2026 to further document the unionid species present, targeting the EPM. Prior to these future surveys, we recommend conducting habitat evaluations to determine the most likely areas for EPM to exist, if present, and to target these areas.

Platform 5: Expanding our knowledge of freshwater mussel species occurrence and distribution across Toronto and Region Conservation Authority's jurisdiction

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Toronto and Region Conservation Authority's (TRCA's) jurisdiction spans nine watersheds and extends between the Etobicoke Creek watershed in the west to Carruther's Creek watershed in the east. The jurisdiction also includes the Lake Ontario waterfront. There is a gradient of land use across the region with greater amounts of urban development and impervious cover in the southern portions of the watersheds and predominantly rural/agricultural land use in the northern regions. Extensive monitoring occurs for fish and benthic macroinvertebrates as part of TRCA's Regional Watershed Monitoring Program and in support of development applications; however, there is limited knowledge of the diversity, abundance, and distribution of freshwater mussel species across the jurisdiction. A limited number of targeted freshwater mussel sampling events have occurred since 2005. Many Species at Risk freshwater mussel distribution maps indicate they occur to the east and west of the jurisdiction which suggests some species may persist in less developed areas. However, in the absence of sampling this cannot be confirmed. For example, until targeted freshwater mussel surveys occurred in several river mouths to Lake Ontario, Eastern Pondmussel (*Ligumia nasuta*) was not known in the jurisdiction (COSSARO 2018). This presentation will: i) provide an overview of freshwater mussel sampling in TRCA's jurisdiction since the early 2000s, ii) highlight priority areas for future sampling, and iii) present important research and management questions related to freshwater mussels in the jurisdiction.

Platform 6: Conservation status of *Toxolasma parvum* (Lilliput) in Canada

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Toxolasma parvum (Lilliput) is currently listed as Endangered in Canada under the federal *Species at Risk Act* (SARA). When the species was first assessed in 2013 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the distribution from 1997 – 2011 reported 39 live individuals from 12 live records. Lilliput are due for reassessment in spring 2024 and recent evidence suggests the low detection may be due to limited targeted sampling in their preferred habitat. In 2022, Fisheries and Oceans Canada (DFO) completed targeted sampling in Lilliput preferred habitat at 28 sites in the Lake St. Clair watershed, 5 sites in the Lake Erie watershed, and 2 sites in the Lake Ontario watershed. A semi-quantitative timed-search survey was conducted at each site using a search effort of 4.5 person-hours at each site. Fifty-five live Lilliput were detected, with presence at 50% of sites and occurrence in 83% of waterbodies surveyed in the Lake St. Clair watershed. Mean site CPUE (± standard error) for this watershed was 0.44 mussels/hour ± 0.19. Lilliput was not detected at any sites in the Lake Erie watershed or Lake Ontario watershed during these targeted surveys; however, there have been notable collections of numerous live Lilliput in the western portion of the Lake Ontario watershed in recent years. Since the last assessment, 559 live individuals (from 98 live records) have been found in an additional 28 waterbodies. The discovery of the species in seven of these waterbodies is a direct result of the targeted surveys. Information collected through targeted sampling of the species and assessment of life history characteristics will aid in the upcoming COSEWIC reassessment and the ongoing management of the species.

Platform 7: A comparison of freshwater mussel species detection and abundance across different survey methods

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Freshwater mussels are vital components of healthy aquatic systems, playing a crucial role in water quality and ecosystem health. Accurate assessments of mussel populations are essential for conservation efforts, yet different survey methods can yield significantly different results, and some are conducted in tandem. In our study, we utilized three distinct survey methods (shells, qualitative, quantitative) for freshwater mussels and assessed their efficacy in detecting species and quantifying abundance at 10 reaches in the Verdigris River, Oklahoma. At each reach, we surveyed for shells of recently dead individuals along four, 100-meter transects. Then, a 60-minute timed snorkel survey was performed throughout the site to rapidly determine species occurrence and abundance (qualitative survey). Finally, we conducted a quantitative survey with 25, 1-m^2 quadrats randomly distributed throughout the site. Quadrats were excavated for a total of 20 minutes to a depth of approximately 6 cm. Shell surveys poorly captured the full community of freshwater mussel species present, with 16/19 species found alive at reaches without representative shells. Snorkel surveys and quadrat surveys performed similarly for species richness (mean Jaccard similarity = 0.80) but not community composition (mean Bray-Curtis similarity = 0.30). Quadrat data produced the most species and abundance, but with much greater effort (10 hours total for snorkeling compared to 83 hours for quadrats). Rarefaction of quadrat data to the same level of effort of snorkeling for the entire river showed that it would take 65 quadrats to achieve the same abundance levels as the snorkel surveys, and 79 quadrats to achieve the same species richness. At this level of effort, quadrats can provide robust density estimates, while saving time, which is an advantage of snorkeling surveys.

Platform 8: Update on mussel brail sampling in non-wadeable habitats along southwestern Ontario rivers

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Mussel surveys of southern Ontario rivers have largely been limited to habitats suitable for wading or snorkelling (i.e. less than 1 m deep). For these habitats, sampling protocols have been developed to survey and monitor mussel species at risk populations. However, methods are required for deeper habitats so that habitat descriptions can be refined, and population status associated with these habitats can be monitored. In 2019 and 2022, surveys of non-wadeable habitats using a mussel brail were done at 142 sites along four southwestern Ontario rivers (Ausable, Grand, Sydenham and Thames). In total, 891 live individuals were collected by the brail, representing 19 species. Six species at risk were collected including: Fawnsfoot, Kidneyshell, Mapleleaf, Purple Wartyback, Round Pigtoe, and Threehorn Wartyback. Habitat sampling with the Petite Ponar™ benthic grab provided additional distribution information on four mussel species at risk (Eastern Pondmussel, Lilliput, Mapleleaf, and Round Pigtoe). There were large among-river and between season differences in the number of individuals collected and species detected. Along the lower Grand River, among-site differences in the composition of mussel assemblages were related to distance from Lake Erie, channel width, water depth and riverbed material. Preliminary results from the Sydenham and Thames rivers indicate that species detection can be improved by multiple successive samples of transects. Results indicate that brail sampling can complement existing methods to monitor mussel assemblages in southern Ontario rivers.

Platform 9: Salt, time, and toxicity: Comparing the toxicity of sulfate to adult freshwater mussels in a 7-day versus a 28-day laboratory exposure

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Anthropogenic activities introduce a suite of contaminants to aquatic environments impacting the water quality of surrounding areas, and by extension the health of the organisms living there. Semi-quantitative visual surveys in Boston Creek (Grand River (ON) tributary) found that freshwater mussels living downstream of an industrial effluent were significantly smaller than those upstream of the gypsum plant. Water quality assessment downstream of the effluent release revealed high conductivity (~2000 μS) and elevated concentrations of major ions, including sulfate, which approached previously reported toxic levels for some freshwater mussel species. In an effort to investigate what may be driving the observed changes in wild mussels, lab studies were initiated with adult Spike (*Eurynia dilatata*). Mussels were exposed to six concentrations of sulfate (as sodium sulfate) in both a 7-day and a 28-day exposure. This parallel design allowed us to examine the influence of exposure duration on toxicity and determine whether additional exposure time would refine the derived toxicity metrics. These toxicity tests were conducted using a new flow through system called a proportional diluter that allows for automated solution renewal throughout the exposure period. The objectives of this project were threefold: to determine the toxicity threshold of sulfates to adult freshwater mussels, to investigate the influence of exposure duration on toxicity outcomes, and to introduce the proportional diluter as a new tool in our ecotoxicology program. The LC50 values derived from the 7-day and 28-day sulfate exposures were 4,245 mg/L [Standard Error (SE): 25,092] and 2,812 mg/L (SE: 1,528) respectively, indicating that extended exposure time increases mussel sensitivity to sulfates and reduces the uncertainty associated with the toxicity estimate (i.e., LC50). While acute toxicity was not observed in lab-exposed mussels at the sulfate level measured in Boston Creek (1,090 mg/L), further research is needed to determine potential chronic effects. Moving forward the hope is to introduce this system, and the methods identified in these tests, to future projects working with more complex contaminants.

Platform 10: Assessing toxicity and bioconcentration of the pharmaceutical Atovaquone in unionid mussels

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Atovaquone (ATO) is a drug administered for the prevention and treatment of malaria and toxoplasmosis due to its broad-spectrum antiprotozoal properties. Although ATO has the potential to enter surface waters via municipal wastewater treatment plant effluents, little is known on the fate and toxicity of ATO in the environment. In order to predict the risk ATO poses to aquatic ecosystems information on its toxicity and ability to bioconcentrate is needed. The toxicity of ATO to two benthic invertebrates was assessed: adult freshwater mussels (*Eurynia dilatata*) and midge larvae (*Chironomus riparius*). For mussels, the measured concentration of ATO that was lethal to 50% of exposed organisms (i.e., LC50) after 14 days of aqueous exposure was 83.7 µg/L and the LC10 was 54.2 µg/L. While no mortality occurred at the highest tested concentration (433.5 µg ATO/g), effects on *C. riparius* growth were observed with 50% reduction at ~355 µg ATO/g sediment. ATO bioconcentration was assessed using lab-exposed adult mussels. The uptake (28 d) and depuration (14 d) patterns of aqueous ATO were investigated using standard methods. Despite complicating factors related to solubility, mussels were shown to accumulate ATO in their tissues during the exposure period at two different concentrations (10 and 100 µg/L). The concentration of ATO in mussels showed an average (Log2) fold-increase of 1.9 in the 10 µg/L treatment and 3.1 in the 100 µg/L from day 1 to 28 of the exposure period. Once the exposed mussels were transferred to clean water, they were able to depurate most of the accumulated ATO. After 14 days of depuration ATO concentrations had declined by an average (Log2) fold-reduction of -2.3 in both treatments, indicating that 80% of accumulated ATO was eliminated from their tissues post-exposure. Analysis of ATO in samples of municipal wastewater effluents and surface water from an urban river revealed that levels were below the detection limit (13 ng/L) in all sampled surface waters and in 6 of the 7 wastewater effluents examined. The effluent from the seventh treatment plant contained 15.5 ng ATO/L. Data generated in this study will support the risk assessment activities of Health Canada.

Platform 11: Multiple stressors in microplates: adapting standard ecotoxicity methods for mixture tests

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Understanding biological responses to environmental toxicants is an important step in determining risk to humans and the environment. Ecotoxicology methods have been developed to test this, typically investigating the response of a single species to a single contaminant. However, organisms are exposed to not one, but many anthropogenic stressors, particularly in aquatic environments. Thus, ecotoxicology methods need to evolve to reflect the circumstances in the environment. In our study, we modified standard toxicity test protocols for two common aquatic species, juvenile *Lampsilis siliquoidea* and *Daphnia magna* neonates (<24 hr), to facilitate multiple stressor testing and downstream genetic analysis. Specifically, we altered the test container (standard: beaker, modified: 24-wellplate) and temperature (standard: room temperature, modified: 8 and 10 degrees), and compared survival between standard and modified treatments. We also tested the response of organisms to a common reference toxicant, sodium chloride (NaCl), using both methods. Results demonstrate that conducting tests in a 24-wellplate did not affect organism survival in a 48-hr exposure, nor did reduced temperatures (which can be changed to assess effects relevant to different seasons). Moreover, we did not observe differences in effects between methods when exposing organisms to a reference toxicant. Together, these methods demonstrate that standard tests can be modified to facilitate high throughput, multiple stressor testing without compromising the validity of results. These results can serve as a screening tool for more in-depth testing of chemical mixtures, eventually aiding decision making.

Platform 12: Minding the (data) gap: Development of toxicity test methods with often-overlooked freshwater snails

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Freshwater snails are an important component of aquatic ecosystems. They are present in diverse habitats, can dominate aquatic communities, contribute to nutrient cycling, and are an important food source for predators. Also, along with other molluscs, freshwater snails are amongst the most imperiled invertebrate taxa due to human activities, and they are sensitive to some aquatic contaminants (e.g., some metals, butyltins, bisphenol A). Until recently, freshwater snails were generally overlooked in ecological risk assessments, yet recent efforts to develop internationally standardized toxicity testing procedures have been fruitful. Over the last five years, research in our laboratory has focused on developing standardized testing procedures with freshwater snails, particularly *Planorbella pilsbryi*, a pulmonate freshwater snail common to watersheds across North America. This species is easy to culture and has a short life span relative to other freshwater molluscs, making it an excellent candidate for multi-generation testing. We will present some of our research on the use of freshwater snails for ecotoxicological testing in support of Environment and Climate Change Canada's mandate and commitments under the Canadian Environmental Protection Act. Laboratory methods include acute and chronic toxicity tests with various life stages, a partial multi-generation test, and a behaviour assay (under development). We also designed snail cages for in-situ deployment in aquatic habitats. These cages have been used in projects across southern Ontario, in the Bay of Quinte, and in the St. Lawrence River. Once we have shared our enthusiasm for these cool creatures, we will propose areas for future research.

Platform 13: Assessing the toxicity of recreational lead fishing gear in the freshwater snail *Planorbella pilsbryi*

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Lead is a soft metallic element that is mined widely across the world and is available at a low cost for use in consumer products. Lead has neurotoxic and developmental effects on humans and wildlife, and anthropogenic sources of lead in the environment remain a concern requiring further analysis to understand exposure risks. Sinkers and jigs made from lead in recreational fishing gear often remain in the environment and have a high potential for being ingested by wildlife, including waterfowl and fish. Such wildlife species prey on freshwater snails, yet the relationship is not well understood. These concerns are being addressed by the Chemicals Management Plan, a Government of Canada initiative aiming to reduce the risks posed by chemicals to Canadians and their environment.

In the present study, we assessed the chronic toxicity of lead (II) nitrate in two life stages of the freshwater snail *Planorbella pilsbryi* in a 28-d assay with adult snails, a 21-d assay with F0 generation embryos, and a 21-d assay with F1 generation embryos. We also assessed the chronic toxicity of lead slurries made using two different types of fishing sinkers in a 21-d assay with embryos. To investigate environmental lead concerns, we also conducted a 14-d field exposure with adult snails at three sites in the Bay of Quinte, ON, and sampled water and sediment for analysis. At higher concentrations of lead (II) nitrate, we observed significant reductions in growth and fertility in the adult snails, which was also observed at one of the three field sites. The snail embryos exhibited delays in hatching after exposure to both the lead slurries and higher concentrations of lead (II) nitrate.

We preserved all snail tissues and plan to investigate the changes in metabolites at a molecular level using metabolomic techniques to better understand the sublethal and chronic molecular effects of lead exposure. This study will build upon the current knowledge of lead exposure from recreational fishing gear to inform better management practices in the future.

Platform 14: Is older and wiser really better: The effect of age on the fertility and fecundity of *Planorbella pilsbryi*

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Planorbella pilsbryi is a species of freshwater snail native to Canada and the United States, which is an important component of healthy aquatic ecosystems. This species has been used in toxicity tests for years to analyze a variety of environmental contaminants due to its high reproduction rate, easy care and handling, and simple test conditions requirements. We have used this organism in a variety of assays, including 28-d chronic adult tests, 28-d juvenile behaviour tests, and 21-d embryo development tests. The ideal age for adults used in chronic embryo tests is still being understood and we wanted to optimize the age range of snails used in toxicity testing to eliminate age as a factor in poor embryo development. Chronic embryo development tests involve observing egg masses for delays in hatching and deformities in embryo development from exposure to a toxicant of interest. In these tests, we collect egg masses from the adult snails and place them into 24-well culture plates to be observed over a period of 21 days using a dissecting microscope. We take photos on day 0, day 3, day 7 and each day beyond day 7 to observe fertilization, time taken to hatch, and developmental progress. We observed that the age of *P. pilsbryi* influences the quality of embryos that the species produces, including the number of embryos per egg mass. In the present study, we obtained seven groups of *P. pilsbryi* aged 12 – 30 weeks old. We collected 24 egg masses from each group and observed them for 21 days for differences in fertilization, hatching, and development. We confirmed that the ideal age of snails without impacting the quality of their egg masses was 12 – 21 weeks old. Standardizing the age of snails chosen to produce testable embryos will yield reliable results in future toxicity testing of *P. pilsbryi* and will provide meaningful age data for comparison to previous studies.

Platform 15: Microplastics in freshwater bivalves chronically exposed to wastewater effluent in the Grand River, Ontario

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Microplastics (MPs) enter aquatic environments through many sources, including wastewater treatment plants (WWTPs), but their uptake by aquatic organisms is poorly understood. Freshwater bivalves accumulate multiple contaminants, making them potential bioindicators for MP pollution. This study aims to understand the abundance and characteristics of microplastics that accumulate in wild bivalves. Samples were collected from 5 locations along the Grand River (Ontario, Canada) in 2021-2022, including 3 municipal WWTPs where both an upstream and downstream site were sampled. At each site, fingernail clams (*Sphaeriidae*, n=5 composite samples), flutedshell mussels (*Lasmigona costata*, n=10), and surface water (n=3) were sampled. Within the mussels, the gill, digestive gland, and hemolymph tissues were targeted and compared. Microplastics were isolated and quantified via stereomicroscopy, and the chemical composition is being determined using FT-IR spectroscopy. Fibers were the dominant morphology and clear, blue, and black were the most common colours, but there were some differences among sites and sample types. Most MPs were between 80 µm and 1 mm in length. Fingernail clams contained the highest MP counts per mass of tissue at 35.5 ± 29.4 microplastics/g, mussel tissues ranged from 4.3 ± 4.2 microplastics/mL to 6.5 ± 8.1 microplastics/g, and water samples contained the lowest counts at 0.0055 ± 0.0028 microplastics/mL. Elevated MP counts at downstream sites were only seen in mussel gills and not other bivalve tissues. Surface water samples did not show elevated counts downstream of the WWTPs and microplastic exposures were similar across sites. This study provides baseline data for future monitoring and informs toxicity studies to assess the risk of MPs to vulnerable freshwater bivalves and other aquatic organisms. Given the ubiquitous nature of microplastics in the Grand River, these results also suggest that other point and non-point sources warrant investigation.

Platform 16: The impacts of zebra mussels (*Dreissena polymorpha*) on native freshwater unionid mussels in Lake Memphrémagog, QC (Virtual)

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Since 2017, Lake Memphrémagog (Québec) has experienced an intensifying invasion by the zebra mussel (*Dreissena polymorpha*). The lake was thought to have a calcium concentration insufficient to support an abundant zebra mussel population; however, local densities in some areas are now as high as those recorded in calcium-rich water bodies. We have observed intense biofouling of native unionid mussels by zebra mussels at levels that have immediately preceded heavy unionid mortality in other invaded lakes and rivers. Remarkably, these fouling intensities have been attained at calcium concentrations (<20 mg/L) deemed by current published risk assessments to be insufficient to generate strong ecological impacts. The observed levels and rates of fouling at some sites, as well as the lower glycogen content in heavily fouled unionids indicate that unionid populations in Lake Memphrémagog are at risk of imminent decline. If this prediction holds, it would demonstrate that strong zebra mussel impacts can occur in a broader range of environmental conditions than previously reported.

Platform 17: Using a spatially-explicit ecological risk assessment to evaluate the risk of lampricides on imperilled unionids

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Sea Lamprey control is conducted throughout the Great Lakes basin as an important component of fisheries management, yet the non-target effects of lampricides on unionids are poorly understood. We examined the risk of spatially targeted chemical lampricides (i.e., granular Bayluscide) on native unionids, many of which are imperilled. We evaluated potential risk by first determining the relationship between unionid abundance, exposure duration, and mortality probability based on published toxicity data. We then applied this relationship to unionid abundance estimates from the Thames and Sydenham rivers in southwestern Ontario to quantify mortality risk to all unionids spp., imperilled unionids, and Mapleleaf. Our results demonstrated that there is substantial mortality risk to native unionids from Bayluscide applications. Imperilled unionids at an application site could range from 1,307 – 1,671 individuals in the Sydenham River and 17 – 77 individuals in the Thames River, depending on substrate composition. Based on surrogate toxicity values, the number of imperilled unionid mortalities at an application site could range from 281 – 610 mortalities in the Sydenham River and 2 – 16 mortalities in the Thames River, depending on substrate composition. This analysis provides valuable information to inform the risk of Sea Lamprey control within the Great Lakes basin as well as other scenarios where toxins present at small spatial scales may affect imperilled species.

Platform 18: Evaluating ecohydraulic trade-offs due to positioning in freshwater mussels in rivers

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Unionid mussels are important components of freshwater because of their roles as ecosystem engineers and as providers of ecosystem services (e.g., water quality and nutrient regulation). Water flow plays a significant role in the life of mussels, facilitating several mass transport processes including food uptake and reproduction. Excessive hydrodynamic forces, however, can lead to the dislodgement of mussels, especially when mussels engage in feeding and reproduction and are exposed above the sediment-water interface. Results from both field observations in southern Ontario rivers and computational fluid dynamic (CFD; COMSOL Multiphysics) modeling of hydrodynamic interactions with *Lampsilis siliquoidea* were used to understand the advantages and disadvantages (i.e., trade-offs) of mussel orientation at different water speed. Mussels oriented at higher angles of attack with respect to the oncoming flow and higher vertical angles with respect to the bottom, had higher drag coefficients in computational models. Higher proportions of these types of orientations were found at lower velocity sites in the field, supporting the hypothesis of a trade-off between mussel orientation and hydrodynamics. These results help to explain observations and increase the understanding of fluid-organism interactions in nature.

Platform 19: The effect of total nitrogen (NH_4^+, NO_3^-, and NO_2^-) flux on nutrient cycling in a freshwater mussel (*Lampsilis siliquoidea*, Fatmucket)

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Freshwater unionid mussels are essential constituents of aquatic ecosystems and are considered ecosystem engineers because of their suspension feeding and burrowing activities. Unionids clear particulate nitrogen, which is then released back into the ecosystem as dissolved ammoniacal nitrogen or as loosely bound biodeposits. Their role in nutrient cycling has been well-documented under static no-flow conditions, but these experimental designs do not account for the effect of water flow on mussel feeding processes or differences in ambient nitrogen concentrations – collectively nitrogen flux [i.e., flux (J) = concentration (C) × velocity (U)]. Mussels clear particles from the water in a non-linear manner with increasing velocity (U) and evidence suggests that nitrogen excretion rates increase with nitrogen concentration (C). The ongoing research is examining whether nitrogen excretion and biodeposition rates of unionid mussels also vary with increased total nitrogen flux (J), as well as how clearance rates are affected by differing nitrogen concentrations in the water column. Adult male *Lampsilis siliquoidea* mussels from the Thames River near Innerkip, Ontario were randomly assigned to one of 16 treatments, which will provide 13 different flux conditions based on combinations of four water velocities (0 cm/s, 5 cm/s, 15 cm/s, or 25 cm/s) and four ambient total nitrogen concentrations (10 µg/L, 100 µg/L, 1000 µg/L, and 10000 µg/L). The clearance, excretion, and biodeposition rates is being determined over two hours in an 18.5 L recirculating flow chamber. The goal of this research is to determine the clearance, excretion, and biodeposition rates of mussels under more natural conditions in which mussels are exposed to nitrogen concentrations and water velocity that vary concurrently. This will allow for a better understanding of the effect of mussel nutrient cycling processes on riverine communities and how these effects may shift with climate-induced changes to baseflow and nutrient loads.

Platform 20: An aquatic species at risk threat assessment and prioritization exercise for the Lower Thames Valley Conservation Authority watershed

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

Platform 21: The forgotten mussel, a consultant's perspective

Victoria Tousaw and Brad Dufour

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LEA Consulting Ltd. (LEA) is a consulting firm that provides Environmental Assessment (EA) services for transportation infrastructure and development projects across Ontario. A component of this work is fisheries assessments to document existing conditions and identify constraints and opportunities as it relates to the project. Assessments focus on identifying the fish community and habitat features present through a combination of field investigations and background research. The results of these assessments inform the planning and design process of the project to ensure compliance with provincial and federal legislation that protects fish and fish habitat.

Mussels are included in the definition of fish under the *Fisheries Act* and receive all the same protections as their swimming counterparts. However, when completing fisheries assessments, mussels are often forgotten unless Species at Risk (SAR) are known to be present. When undertaking fisheries assessments, consultants are often tasked with assessing waterbodies that have never been sampled for mussels. In the absence of occurrence records, it is uncommon for consultants to conduct targeted mussel surveys. Further, information on existing conditions of the mussel community and habitat are often not reported or considered when completing the project impact assessment.

Over the past 3 field seasons, LEA has incorporated mussel surveys into fisheries assessments, surveying multiple remote or previously unsampled waterbodies across the province. LEA uses a qualitative sampling methodology to conduct preliminary screening level surveys using viewers, snorkels, and tactile search methods. All mussels found are identified to species, photographed, and reported alongside fish catch records to the Ministry of Natural Resources and Forestry (MNRF) as required under the *Fish and Wildlife Conservation Act*. The results of these surveys are also included in reports and considered when evaluating the project impacts. From these surveys, LEA has confirmed the presence of mussels in 7 different waterbodies across Ontario where current baseline data does not exist.

Incorporating screening level mussel surveys into fisheries assessments undertaken by consultants provides a unique opportunity to expand our collective knowledge of mussel distribution across the province. LEA has implemented a practical and cost-effective approach to incorporate these surveys into fisheries assessments that could be easily adopted by others. Increasing baseline occurrence and distribution records of mussels across the province will provide the foundation for stakeholders and regulators to raise awareness and augment current conservation and protection.

Platform 22: A dangerous shell game: diving into the history of commercial freshwater mussel harvests in Canada

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Freshwater mussels (Bivalvia: Unionidae) have long been an important aquatic resource as North America's Indigenous Nations have harvested freshwater mussels for over 10,000 years. Examination of middens and other archaeological sites suggests that while mussel use was primarily for food, shells were also used for other purposes including tools (spoons, dippers and scrapers), fishing lures, and less often for decorative items. The collection, use and trade of freshwater pearls was a common practice amongst many Indigenous communities as well. The history of European exploitation begins in the latter half of the 19th century initially focused on the collection of pearls and then shifting its focus to the manufacturing of buttons at the onset of the 20th century. The first commercial pearl button factory in North America began full operation in 1892 in Muscatine, Iowa and by 1900 there were 70 factories in operation in the Mississippi valley. Canadian pearl button factories were in operation in Windsor, Berlin (now Kitchener) and Trenton, Ontario by 1911. While these factories may have initially focused on shells imported from the United States, it appears that local shells from the Grand and Thames rivers were being used to supplement these imports from the start. By 1913, Ontario shell was reportedly being exported to factories in the United States. Like its American counterpart, the Canadian harvest did not last long and had come to an end by the mid-1940s as resources dwindled due to over-exploitation, pollution induced declines and shifts to other raw materials for buttons (e.g., plastics). Although collection records are sparse, available information indicates annual river-specific harvest of 60-100 tons with a maximum of 265 tons (approximately 1 – 4 million animals) collected at Dunnville on the lower Grand River in 1915. Although detailed collection information is lacking it appears that species such as Mucket, Threeridge, Round Pigtoe (now federally Endangered), Plain Pocketbook, Pink Heelsplitter Black Sandshell, Mapleleaf (now federally Special Concern), and Threehorn Wartyback (now federally Threatened) were targeted while Purple Wartyback (now federally Endangered) was discarded. Commercial harvests of the type seen in Ontario typically targeted adults as they provided the desired quantity and type of material resulting in directed mortality on this life stage. Recent studies have shown that this type of directed mortality can have the greatest potential impact on the long term persistence of these populations and although the specific impacts of the historical harvest cannot be determined, it is likely that these harvests have contributed to the current state of imperilment of this fauna.

Platform 23: The effect of riparian vegetation buffers on unionid mussel habitats (Virtual)

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Freshwater unionids mussels are an ecologically important and imperiled taxon whose conservation is essential for protecting freshwater ecosystems. Conservation efforts aimed at unionids includes best management practices such as the construction or preservation of riparian vegetation buffers. However, the effectiveness of vegetation buffers at conserving aquatic habitats has been equivocal, and the habitat requirements of unionids – especially juvenile unionids – are not well understood. An examination of the effectiveness of riparian buffers at conserving mussel habitats will help facilitate their conservation. A partial least square (PLM) path analysis indicated strong associations between good habitat quality (low ammonia, high DO, high diatom and chlorophytes, low cyanobacteria) and high hyporheic hydraulic conductivity resulting from low fine sediments. Comparisons of habitat quality between sites on the East and North Sydenham River (Ontario, Canada) revealed higher quality habitats in sites with intact vs. fragmented buffers, though differences were not significant in the north branch possible due to geomorphology containing more fine sediments. Adult mussels were located more in higher quality habitats, suggesting that riparian buffers can maintain good mussel habitats. However, conclusions on juvenile mussel habitats could not be made due to low observations. This study provides evidence for the importance of riparian buffers for maintaining mussel habitats, and the impact of fine sediments on habitat quality.

Platform 24: Approaches and challenges in executing a large-scale mussel relocation effort on the Wisconsin River

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The Wisconsin River is the longest river in Wisconsin, spanning 430 miles before its confluence with the Mississippi River. The Wisconsin River provides critical habitat to multiple threatened and endangered aquatic species, including federally listed Higgins eye (*Lampsilis higginsii*) and Sheepnose (*Plethobasus cyphyus*) mussels, and state listed Salamander mussel (*Simpsonaias ambigua*). In advance of major bridge construction over the Wisconsin River, GEI Consultants was contracted to conduct a mussel relocation within the area of direct impact (ADI) and buffer areas. Mussel relocation was required due to the presence of federally listed species within the given river reach and previous data indicating potentially high mussel abundance. Mussel relocation efforts encompassed a collaborative multi-year effort including over 45 staff from 16 GEI offices (thus far) and collaboration with Daguna Consulting, LLC, with the latter being the federal permit holder for this project. A review of previous mussel community and substrate data, in addition to information from a preliminary site visit were used to develop a mussel relocation approach, identifying primary and secondary mussel salvage zones. Mussel searches were conducted in 400 m^2 (20 x 20 m) blocks across the ADI. Within each block transects were set parallel to flow every 2 m, with pairs of SCUBA divers clearing mussels on both sides of every transect, making at least two passes. Search rates were scaled in accordance with substrate quality and mussel abundance, with average search times per pass generally being 2-5 min/m^2. More than 9,000 mussels were relocated, including 15 *P. cyphyus*, with 24 species recovered. Noteworthy challenges of this project included but were not limited to expedited multi-agency approval of the mussel relocation approach and plan, the scale of the project area, logistics of continuous staffing and equipment, site access, highly variable water depth and visibility, and level of effort and logistics of processing upwards of 600 mussels per day. The success and challenges of summer 2023 relocation efforts will help in developing future action plans for this ongoing project, as well as developing future mussel relocation efforts in the Great Lakes region.

Platform 25: Evaluating the effects of translocations on freshwater mussel communities as a conservation mitigation tool

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Freshwater mussels (Unionidae) serve as critical structural and functional links for aquatic food webs and are bioindicators of ecosystem health. Unfortunately, many species are declining globally, including in Canada where many are listed as species-at-risk of extinction (SAR). Restricted in their ability to move readily throughout riverbed habitats, Unionidae are vulnerable to human activities such as infrastructure projects - namely bridge construction, culvert replacements and earth moving which can take place in or adjacent to rivers. Translocation efforts are a common mitigation response under the federal *Fisheries Act* and *Species at Risk Act*. Since publication of a standardized protocol for freshwater mussel translocations, practitioners have been conducting translocations with little to no follow-up or evaluation of this practice. To address this, we synthesized translocation reports spanning 15 years, calculating recovery rates at 1 month, 1 year, and 2 years post translocation. We examined diversity and abundances as well as community composition as part of the synthesis. Additionally, sites of previous translocations in the Grand and Thames River watersheds located in southern Ontario were surveyed during 2022 to expand upon the submitted reports. Together these data were combined to assess the effectiveness of SAR policy. Preliminary findings indicate that mussel communities do not fully recover following translocation, negatively affecting overall population density and biodiversity of freshwater communities. My research offers evidence to improve conservation within the species-at-risk policy and practice in support of coordinated actions including habitat restoration and benthic macroinvertebrate community indicators.

Platform 26: Harmonization of datasets among and within organizations accelerate efforts to save at-risk unionids in the Sydenham River watershed

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The Sydenham River watershed covers nearly 3,000 km^2 and is widely known for its high level of biodiversity. With 35 species of freshwater mussels, 14 of which are federally listed species at risk, the Sydenham is known as the most biodiverse in Canada for mussel species. Mussel species continue to be largely underexplored in terms of distribution, population size, life history traits, and co-existence with host fishes, making conservation and restoration efforts a challenge. To advance the conservation of freshwater mussel species at risk, and accelerate restoration efforts on the ground, this project aims to harmonize existing freshwater mussel species at risk distribution data together with other forms of knowledge through a harmonized approach. As more mussel species continue to be listed as at-risk, there is a growing, urgent need to harness existing datasets and work collaboratively across organizations to simultaneously conserve species at risk and restore their critical habitats. Currently, there is a knowledge gap regarding mussel and host fish relationships; many host fishes are unknown and threats to relationships are vague. Stronger collaborations, including amongst fish and mussel biologists, could help identify shared research directions across and among organizations. Here I present findings from an interdisciplinary project using the Sydenham River watershed as a case study. I engaged multiple research methods, including an empirical field survey of existing mussel assemblages and environmental conditions across the watershed, a literature synthesis to compile all available host fish data, and expert input to refine local host information for the watershed. In my empirical survey, I found two major patterns in assemblages across the watershed: habitats within the main stem East branch of the watershed were significantly richer and significantly different based on environmental characteristics than the North branch. Additionally, host fishes were not very good predictors for where SAR freshwater mussels reside. Further, habitat characteristics informed mussel assemblage composition. My results offered multiple lines of evidence to demonstrate that harmonizing available datasets can help better understand mussel communities and can be applied to watershed-scale restoration efforts in the Great Lakes and beyond.

Platform 27: Highly variable populations of endangered Snuffbox across Michigan: How the focus on Snuffbox may help unionid conservation (Virtual)

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Snuffbox (*Epioblasma triquetra*) is a globally rare unionid species that is federally endangered in the United States and Canada. Snuffbox, compared to historic records, has experienced a 60% range compaction and currently inhabits the Great Lakes, Appalachia, and parts of the Mississippi River drainages. At Central Michigan University (CMU) we have been studying Snuffbox to fill in data gaps using these three general approaches: 1) considerations of fragmentation of Snuffbox habitat, 2) focused surveys of known populations, and 3) advances in potential Snuffbox propagation for Michigan. Fragmentation studies have occurred in two watersheds (Grand River and Tittabawassee River) prior to dam removals and post dam failures in known Snuffbox habitat. Snuffbox populations and sympatric unionid communities have been relocated, tracked, and/or assessed for influence of fragmentation. In the focused surveys 253 live Snuffbox were found in 180 person hours with targeted, but standardized, surveys at all known Snuffbox sites across Michigan. The Snuffbox had a highly variable catch per unit effort (live snuffbox per person hour; CPUE) that varied from 0.09 to 9.57 across sites. Snuffbox sex ratios, CPUE, lengths, and ages in the Huron River watershed, St. Clair River watershed, and the Tobacco River suggest these populations are at-risk of decline or are declining while other Snuffbox populations across Michigan are potentially stable and many are showing signs of reproduction. Unionid community was compared among sites and we highlight potential sites for Snuffbox reintroductions or augmentations. CMU has worked with collaborators to try *in situ* propagation of Snuffbox in fish ladders and development of hatchery propagation facilities that have had variable successes. Focusing on multiple aspects of Snuffbox conservation and assessment is likely important to the conservation of Snuffbox in the Great Lakes region and we will present how this could aid in all unionid conservation.

Platform 28: Identifying environmental drivers of shell shape variation in the freshwater gastropod *Campeloma decisum*

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Freshwater gastropods are important indicators of ecosystem health. Many native gastropod species are considered highly imperiled while other non-indigenous species are considered damaging invaders. *Campeloma decisum*, Pointed Campeloma, is a common freshwater gastropod from family Viviparidae found in varied habitats across the eastern United States and southeastern Canada. Our study sought to increase the knowledge on *C. decisum* using geometric morphometric analyses to test which environmental factors may be driving shell shape variation. *C. decisum* (n = 458) and environmental data were collected from 22 sites in 6 lakes in central and northern Michigan. Specimens were photographed with apertures orthogonal to the camera lens and 26 landmarks were digitized onto each shell image to estimate shell and aperture shape. A Procrustes superimposition was performed to scale and rotate the shells to focus analyses solely on shape. Linear discriminant analyses (LDA) were run to quantify shape variation among the sites and lakes sampled. Correlations were tested for among environmental variables and LDA axes that defined shell shape. The LDA assigned 80.8% of snails to their site of origin and 96.5% to their lake of origin. Shell shapes of *C. decisum* were most strongly correlated with ammonia concentration, phosphate concentration, pH, and sand substrates. Higher ammonia and phosphate concentrations often correlated with more elongate shapes (i.e., taller spire). The pH at sites and lakes appeared to be a strong driver of spire decollation with more acidic conditions likely breaking down calcium carbonate in shells. In contrast to a previous study on the often sympatric freshwater gastropod *Elimia livescens* (family Pleuroceridae), our study found that lake fetch was not as clear of a driver of shell shape in *C. decisum*. We recommend collecting additional *C. decisum* specimens from lakes with longer fetch to expand the dataset and further effects of lake morphometry on shell shape. Understanding forces that drive the ecology and evolution of taxa guide the conservation and recovery of imperiled gastropods and provide insight for controlling the spread of non-indigenous species in a rapidly changing environment.

Platform 29: Microbead models of larval and juvenile mussels go with the flow: Dispersal in reaches with different hydrodynamic conditions

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Freshwater mussel (Unionidae) dispersal is sensitive to stream hydrology because their larvae and juveniles are transported freely in the water column before settling in potential habitat on the riverbed. The dispersal of unionids can differ substantially within and among river systems due in part to variation in hydrodynamic and substrate conditions. We examined the effects of riverbed roughness on larval and juvenile unionid mussel dispersal in the near field region (i.e., < 100 m; before scalars mix across the width of the river) by releasing biodegradable microbead models in three tributaries of the Grand River (ON, Canada) that exhibited a gradient of bed roughness (*k*) and turbulence (TKE and *u**; Speed River < Grand River < Conestogo River). Based on hydrodynamics, we predicted that higher velocities would lead to more downstream transport and that diffusivities based on channel hydraulics and particle capture data would match the gradients in roughness and turbulence. Whereas the Conestogo River site had the highest downstream transport of particles and diffusivities as predicted by simple empirical equations, surprisingly, the Grand River had the lowest downstream transport and particle diffusivities. These differences in diffusivities and flux were far greater than expected based on the relatively small differences in reach-averaged mean velocities of the Grand and Conestogo rivers. This apparent mismatch between diffusivities predicted by simple empirical models and those fit to an advection-diffusion model using particle capture data appear to be due to differences in the inertial properties (i.e., flow speed and direction) of the flow in the advective zone (i.e., near field) of the different reaches. Velocities (*u, v,* and, especially *w*) sampled locally at drift net locations were spatially heterogeneous within and among reaches and demonstrated the influence of the direction of flow on local particle fluxes. Bulk fluid statistics may provide an indication of how dispersal distances vary among rivers but near field dynamics can be complex and require high-resolution bathymetry and velocity data as well as improvements in advection-diffusion modeling.

Platform 30: Temporal dynamics of the host-parasite relationship in freshwater mussels: An attempt to partition hosts

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Freshwater unionid mussels, which have parasitic glochidia larvae, often occur in multispecies mussel beds where they likely compete for host fishes. The temporal dynamics of glochidia release was examined at 2-h intervals over ten 24-h periods in the Sydenham River, Ontario, Canada from late August through September 2020 using a rosette water sampler. A total of 6,104 glochidia from 17 species were identified morphometrically and these were dominated numerically by four species, including: *Eurynia dilatata*; *Ortmanniana ligamentina*; *Epioblasma triquetra*; and *Cyclonaias tuberculata*. The total glochidia abundance was greatest during the night, 20:00 (± 1 h) local solar time (LST) in part because of the dominant species. Conversely, the abundance of glochidia from individual species was not uniform temporally among days ($p < 0.001$) nor time-of-day ($p < 0.001$), but appeared for 10 species to coincide with the reported diel activity periods (i.e., diurnal, crepuscular, and nocturnal) of their host fishes. The abundance of glochidia peaked at different times in unionid species that shared hosts (five cases), suggesting that unionids were trying to minimize competition through temporal partitioning of resources (i.e., host fishes). These results may provide a mechanism by which multiple species of unionids coexist in the same habitat while informing conservation approaches that address mussel-host fish relationships in this imperiled taxon.

POSTER PRESENTATION ABSTRACTS

Poster 1: Exploring the fish-mussel connection in a Canadian context

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Freshwater mussels of the order Unionida are globally distributed and comprise six extant families. Unionid mussels are also one of the most imperilled groups of animals on the planet, with a high percentage of at-risk taxa. These mussels have a unique lifecycle in which the female releases parasitic larvae called glochidia. To reach maturity, glochidia must successfully attach to either the fins or gills of a host fish where they complete a metamorphosis and are released as juveniles. After this point, the mussels are (effectively) sessile for the remainder of their lifecycle. Freshwater mussels (most species) are thus entirely reliant on their host fish, not only for metamorphosis completion, but also for long distance dispersal, including upstream dispersal in streams and rivers. The specificity and selectivity of the fish-mussel relationship varies interspecifically, spatially, and at the population level. Much of the knowledge regarding the fish-mussel connection comes from studies conducted south of the Canadian border, which often have widely different climatic and environmental conditions. As such, this M.Sc. thesis will aim to comprehensively review what is currently known about the relationships between Canadian freshwater mussels and their host fish(es). In addition, we plan to expand upon the knowledge base by studying one of the most common mussel species in eastern North America, the Eastern Elliptio (*Elliptio complanata),* a species that plays a most important ecological role in thousands of lakes, streams and rivers in Eastern Canada. Targeted lab work will be conducted to determine the reproductive phenology of *Elliptio complanata* by dissecting gravid females (from a combination of museum collections and field research) and examining the stage of embryonic development within the marsupial pouches. We also aim to verify, and perhaps expand upon, the list of known host fishes through field examination of fish gills from lakes and rivers of Gatineau Park, QC. Summarizing the current knowledge base surrounding the fish-mussel connection and further expanding it in a Canadian context will provide an important resource to management and conservation efforts for this ecologically important guild of freshwater invertebrates.

Poster 2: Assessing the influence of small dams/riverine infrastructure on freshwater unionid species-at-risk population connectivity

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Infrastructure as a result of urbanization and other human related activities has global impacts on freshwater ecosystems. Developments such as culverts, bridges, and dams along large rivers and waterways results in physical alterations and destruction of species habitats. Due to federal policy including the *Species at Risk Act* (SARA), mitigation actions are often required for infrastructure projects including the translocation of unionid species-at-risk. There is limited knowledge on the effectiveness of these practices, in which long-term impacts is readily unknown. Understanding the impacts on species-at-risk habitats and overall ecosystems is essential in the recovery of unionid survival.

The objective of this research is to compare unionid communities and their habitats upstream and below small dams/riverine infrastructure within the Grand River watershed to determine the impacts on species-at-risk (SAR). Here we focused on the Grand River watershed in Kitchener, Ontario, Canada where freshwater unionid species-at-risk are impacted by urbanization and infrastructure development. In 2023, a subset of run-of-the-river dams were selected within the assessed watershed and analyzed for benthic macroinvertebrate communities and habitat analyses to determine the suitability of these habitats and explain the potential decline of SAR due to connectivity. Assessed sites will be re-evaluated for unionid presence/absence and abundance in 2024 across the previous assessed gradient. We predict the SAR unionid communities favour downstream habitats due to the increased water velocity and conductivity, and issues related to connectivity. Additionally, we predict the habitat conditions upstream consist of poorer habitat variables (e.g., fine sediment, decreased water velocity) resulting in less preferable habitats for SAR unionids.

Poster 3: Towards a better understanding of the biology and effects of natural seasonal patterns on endangered freshwater mussels through captive care

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The Hickorynut (*Obovaria olivaria*), a freshwater mussel whose Canadian populations are found in the St. Lawrence River and its many tributaries in Quebec and the Mississagi River in Ontario, was listed as endangered in 2019 under the federal *Species at Risk Act* (SARA). To support the conservation of the Hickorynut, further knowledge needs to be gained on the biology, life cycle and threats of this species, as is also the case for freshwater mussels in general. The capacity to rear these species in tanks allows Fisheries and Oceans (DFO) to study them more closely and contribute to the development of recovery measures for endangered mussels in Canada. To this end, Eastern Elliptio (*Elliptio complanata*) and Eastern Lampmussel (*Lampsilis radiata*), two common species, have been reared in tanks at the indoor facilities of DFO's Maurice Lamontagne Institute since the summer of 2022. The aim of this breeding program was to develop a protocol for keeping freshwater mussels in captivity. Yellow Perch (*Perca flavescens*), a generalist host fish species, have recently been added to the tank culture to experiment with interactions with Eastern Lampmussel. The development of this expertise has enabled us to add the Hickorynut to our tank rearing program. When the host fish and mussel protocols are perfected, we will adopt them for the Hickorynut and its host fish. The aquaculture system consists of eight open-circuit tanks where mussels were segregated by species. A fine sandy substrate, a photoperiod and a temperature regime following natural seasonal patterns ensured rearing conditions that mimic the mussels' natural environment as closely as possible. The mussels were fed every two hours with algae concentrates (Shellfish Diet 1800® and Nanno 3600®) via an automated pump system, and benefited from an aeration system. Water physicochemical parameters (temperature, pH, ammonia and dissolved oxygen) and mussel health (filtration, presence of glochidia and mortality) were monitored daily. Results from this first year in captivity showed different burrowing and reproductive behaviors for each species, depending on the season. This year of development has enabled us to improve our monitoring methods in order to reduce as far as possible the stressors and the factors likely to lead to mortality. The knowledge gained from this study can support and orient management approaches for the recovery and conservation of freshwater mussels and help pave the way for future translocations and reintroductions for species conservation.

Poster 4: Freshwater mussel (family Unionidae) propagation for restoration and water quality improvement in the Niagara River drainage

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Freshwater mussels of the family Unionidae or unionids, once abundant in the upper Niagara River have suffered major decline due to habitat degradation and invasion of dreissenid mussels. Following habitat restoration efforts across the river, we are evaluating the feasibility of a reintroduction program for unionids by propagating juveniles and exposing them to natural conditions in the upper Niagara River. We are starting a small mussel hatchery using a common species, the Fatmucket (*Lampsilis siliquoidea*), and developing region-relevant protocols for mussel propagation. We have collected gravid Fatmuckets from Ellicott Creek near the University at Buffalo that are being held overwinter until their glochidia are fully developed, at which point we will facilitate infestation of hatchery-reared bass (*Micropterus spp.*). When they have reached appropriate size, juveniles will be placed in mussel silos at previously identified sites in late spring to early summer 2024 where their growth and survival will be monitored. Habitat assessment, water quality, and the success of reintroduced mussels will be used to evaluate the effectiveness of restoration efforts. Simultaneously, we will work in collaboration with the Aquarium of Niagara to design a native unionid mussel exhibit in order to educate visitors about mussel conservation. We hope to invigorate native mussel populations, lay the foundations of larger, multi-species conservation work, and build binational and interorganizational cooperatives to conserve Niagara River drainage species.

Poster 5: Dietary exposure of stormwater contaminants in biofilm to *Neocloeon triangulifer* and *Planorbella pilsbryi*

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Biofilms are known to bioconcentrate a variety of aquatic contaminants and are useful tools for characterizing stormwater pollution in urban ecosystems. However, as an important food source for many aquatic biota, concerns arise regarding the potential toxicological risks of contaminant accumulation to biofilm consumers. More, this accumulation may alter the quantity and nutritional quality of the available biofilm crop. To address this, we selected two freshwater invertebrate species as subjects in a series of dietary bioassays: *Neocloeon triangulifer* and *Planorbella pilsbryi*. These are sensitive, ecologically-relevant indicators of biological integrity and can be cultured in a laboratory environment. Treatment diets consisted of biofilm cultured on artificial substrates deployed in 15 stormwater pond sites in Brampton, Ontario, representing a gradient of urbanization. Three control diets included a starved control, culturing diet, and biofilm collected from a relatively pristine river in Ontario. Biofilm samples were analyzed for a suite of ~500 current-use and legacy pesticides, as well as 22 heavy metals. Ash-free dry weight and chlorophyll-a were used as proxies for biofilm nutritional value. Following a 7-day acute trial with *N. triangulifer* nymphs, survival and biomass production were measured. A 28-day chronic trial was used for *P. pilsbryi* juveniles, with endpoints consisting of survival, growth, biomass production, and behaviour. We tested whether treatments with higher pesticide and metal loads had lower nutritional quality, and resulted in differences in measured endpoints in the test subjects. The results of these studies will contribute to the limited knowledge of dietary exposures to environmentally relevant contaminant mixtures.

Poster 6: Exploring the Upper St. Lawrence River and its tributaries for unionid mussels including the Eastern Pondmussel

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Prior to the invasion of dreissenid mussels to the Great Lakes, the Eastern Pondmussel (*Sagittunio nasutus*) was one of the most abundant and widespread native mussel species in Lake Erie, and was known from a few populations around Lake Ontario and from New York tributaries to the Upper St Lawrence River. The previously known populations were eliminated by dreissenid fouling in the 1990s, but remnant populations have been discovered around Lake Ontario and in Frontenac Arch tributaries to the Upper St Lawrence by Fragile Inheritance and the Ontario Ministry of Natural Resources and Forestry. The objective of this study was to update the known distribution of Eastern Pondmussel and other unionid species in the Upper St Lawrence River watershed, using a combined approach of environmental DNA (eDNA) techniques and timed searches. From June to October 2023, 20 sites in tributaries and lakes connecting to the St Lawrence River were surveyed for eDNA samples, with a subset surveyed using visual and tactile timed searches. An additional 40 sites in the St. Lawrence River were sampled for eDNA and additional habitat characteristics including fish assemblages, aquatic vegetation, nutrients, and water quality. A total of 6 species of unionids was documented, including one Eastern Pondmussel. We await the outcome of the analyses of the eDNA samples. This project will help inform recovery actions for Eastern Pondmussel and other freshwater mussels by using new technologies and standard methods to survey for new populations, to quantify distribution and abundance of known populations, and evaluate threats for individual populations. The project is also mobilizing parks, conservation authorities, and citizen scientists to be interested in unionid species, through workshops, collaboration, and publications.

Poster 7: Does stewardship improve stream habitats for unionid species at risk? A Sydenham River case study

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Habitat stewardship is the primary tool for protecting Canada's aquatic species at risk (SAR) from extinction. Stewardship actions which include riparian planting and fencing are implemented with the aim of mitigating negative impacts of land use changes and erosion. In practice, local conservation practitioners are responsible for implementing these actions, however, they are often unable to pursue monitoring post-implementation, especially over longer timescales. Such is the case in the Sydenham River watershed, home to the highest diversity of unionid freshwater mussels. Therefore, this research asks: how effective are habitat stewardship actions in mitigating erosion-based impacts on unionid SAR mussel habitats? We predict that the quality of riparian buffer zone protection will be a more critical driver of SAR populations than habitat stewardship type, size, or age alone. To evaluate this, we are assessing the riparian vegetation, habitat characteristics, soil, stream water quality, sediment, and substrate composition across 10 previously surveyed sites, where unionid SAR mussels have been located. With a balance of sites between the Northern and Eastern branches of the Sydenham River, and stewarded vs non-stewarded sites, and across a gradient of stream sizes, each site will be characterized using streambed grain size analysis, in-stream and riparian soil nutrients. Variables will be combined with benthic and unionid mussel SAR data and explored using multivariate statistics, including PCA, NMDS, CCA and indicator analyses. Together, I will assess the extent to which stewardship correlate with in-stream habitat condition and mussel community composition. Moreover, these results will provide insight into the importance of evaluating stewardship actions post-implementation and informing conservation efforts in support of SAR and healthy stream ecosystems.

Poster 8: Declines in abundance of *Cipangopaludina chinensis* (Chinese Mystery Snail)

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Chinese Mystery Snails are remarkable because of their huge size (to 60 mm high), and uniform dark coloration. Introduced to the Pacific Coast for food by oriental immigrants in the 19th Century, and to many places throughout eastern North America as aquarium snails through the 20th century, these are now widespread in Ontario, often as amazingly abundant populations. We reviewed our Ontario records and found that we had observed 7 apparent declines, 4 sites where the population appeared stable common or abundant, 7 sites where they were abundant and 3 where they were sparse at one visit, and 2 sites where they appeared at places we'd previously repeatedly visited. The declines may be due to control efforts, predation by mammals, onset of Zebra Mussel populations, or drought. We can't certainly assign any of the declines to a particular cause, but we will be looking out for evidence through the 2024 field season.

Poster 9: Drawdowns of Doom: Bio(malaco) diversity impacts of water level management in impoundments

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Triggered by observations of frog and snail mortality at the Kemptville Creek dam in Oxford Mills (especially bushels of *Helisoma campanulatum* shells in some springs), and the paucity of unionids and snails in drawn-down bays of the St. Lawrence Seaway, we're on a campaign to get recognition of the mortality of aquatic species that lowering water levels behind dams brings about. Drawdowns are nominally done to protect infrastructure and provide reserve capacity to hold back water during spring flooding, but it's important that their impacts on the life in the impoundments be noticed and studied, so that these can be taken into account when planning water level management. This need to study includes being alert to the occurrence of drawdowns, so the species and numbers affected can be documented.

Poster 10: Into the deep - *Obovaria olivaria* (Hickorynut) in the Mississagi River

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Obovaria olivaria (Hickorynut) was listed as Endangered under the *Species at Risk Act* 2019. At this time, the species was known to occur in eastern Ontario and Quebec and in the Mississagi River on the north shore of Lake Huron. Prior to 2023, there was limited information available for the Mississagi River subpopulation as a mere five surveys had occurred in the system, finding a total 20 *O. olivaria* at two sites, with shells found at an additional two sites. Due to the lack of distributional information surrounding this species in Mississagi River, Fisheries and Oceans Canada and Mississauga First Nations surveyed 35 sites from Red Rock Falls to the mouth of the Mississagi River in 2023. The river was divided into 20 two kilometre stretches and each stretch was surveyed at least once by divers for one hour and twenty minutes. Stretches were also sampled via snorkel in shallow water if a large number of *O. olivaria* had been found during dive surveys or as time/depth permitted. In total 26 dive sites and nine snorkel sites were completed. A total of 141 *O. olivaria* were found at 18 sites (14 dive, 4 snorkel) with shells found at additional six sites (5 dive, 1 snorkel). Although this species made up < 2% of 7,579 mussels found, it was detected from the mouth of the river to upstream of the town of Ironbridge – a range increase of ~ 28 kms from its previously known distribution in the system. Understanding the distribution of *O. olivaria* in the Mississagi River is of vital importance to conserving and managing the species given its known current range in Canada.

Poster 11: Patterns of shell shape variation in the critically imperiled freshwater mussel genus *Epioblasma*

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The freshwater mussel genus *Epioblasma* comprises 27 species from eastern North America with 2 species being found in southern Canada. Ten species are federally protected under the U.S. *Endangered Species Act* and both of Canada's *Epioblasma* species are protected under the Canada's *Species at Risk Act*. The remaining 17 species are presumed to have gone extinct due to human activity over the past two centuries. Due to their critically imperiled status and extreme rarity, most species have little to no molecular data available for genomic analysis and thus their evolutionary history is poorly understood relative to other North American species. In the absence of molecular data, we set out to better understand aspects of *Epioblasma* ecology and evolution by quantifying and analyzing shell shape. To quantify and assess shell shape variation within and among species, digital photographs of *Epioblasma* specimens (n = 1400) representing all 27 species and 59 different river bodies were sampled from museum collections for geometric morphometric analyses. Each interior shell shape was extracted via Procrustes-transformed landmarks to get a set of coordinates. Linear discriminant analysis was able to correctly identify *Epioblasma* specimens to subgenus at a rate of 82.7%, and groupings formed by a UPGMA cluster analysis were largely consistent with previous subgeneric classifications. A principal component analysis and examination of thin-plate splines were able to quantify differences in male and female *Epioblasma* forms and could be used to explain trends in sexual dimorphism among species and subgenera. Correlation analyses showed relationships between waterbody and specific differences in shell shape among subgenera. This supports Ortmann's Law of Stream Position, with more elongate and obese (i.e., 2-dimensionally rounder) shell shapes in waters with a lower discharge and velocity. Further explorations of the data examining patterns of shell shape and implications for the ecology and evolution of *Epioblasma* are ongoing.