Queen's University Biological Station

Annual Report 2019



Director: Dr. Stephen C. Lougheed

Associate Director: Dr. Shelley A. Arnott

Senior Manager: Sonia Nobrega

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Cover image: American bullfrog, Elbow Lake.

About QUBS

QUBS Mandate

To provide opportunities for teaching and research in biology and related sciences; and to use active stewardship and best management practices to conserve local terrestrial and aquatic environments, and biodiversity.

Specific Mission Statements & Goals

- Providing a dynamic and supportive environment for leading-edge research spanning, but not limited to, conservation, ecology, evolution and environmental studies.
- Supporting and developing undergraduate and graduate courses in field biology, environmental biology and related sciences.
- Acquiring, and protecting in perpetuity representative and/or significant properties, habitats and ecosystems near the field station.
- Providing locally obtained data and electronic resources on climate, the physical environment and biodiversity and making these available through a Geographical Information System and data/information archives.
- Acting as a liaison between university researchers and the local community, and a conduit for dissemination of natural history and scientific knowledge.
- Engaging in outreach to foster public awareness of environmental and conservation issues.

Meet the Team

Director: Dr. Stephen C. Lougheed Associate Director: Dr. Shelley Arnott Senior Manager: Sonia Nobrega **Opinicon, Operations and Stewardship Manager:** Aaron Zolderdo Elbow Lake, Operations and Maintenance Coordinator: Adam Morcom **Outreach and Teaching Coordinator:** Emily Verhoek (on leave starting August) Interim Outreach and Teaching Coordinator: Sami Brown (Aug-Nov) **Interim Outreach and Teaching Coordinator:** Sarah Oldenburger (starting December) Research Coordinator: Dr. Ivana Schoepf Collections and Data Manager: Dr. Adriana Lopez Villalobos Head Cook/Kitchen Manager: Veronika Jaspers-Fayer Maintenance Assistant: Roger Green Eco-Adventure Camp Director: Ruth Bryce **Opinicon Housekeeping:** Diane Bouliane Elbow Housekeeping: Ally Belanger **Opinicon Kitchen Cooks:** Gail Marshall, Gina Rushworth, Claudia Hancock

2019 Summer Work Experience Program (SWEP) Interns at QUBS

The Summer Work Experience Program (SWEP) provides Queen's undergraduate students with an engaging, challenging and rewarding summer work experience, and helps support our spring and summer programming. QUBS is grateful to Queen's Career Services for facilitation the SWEP program, and for the partial funding provided through the undergraduate portion of the Student Assistance Levy.

Youth Environmental Educators (Eco-Adventure Camp Counsellors): Emma Crivello (Assistant Director), Sarah Reddick, James Feschuk, and Nestor Grandal Outreach & Stewardship Interns: Caroline Burchat and Jennifer Cooke Conservation Research Intern: Kestrel DeMarco Field and Data Management Intern: Samantha Anderson Data Management and Herbarium Assistant: Mahsa Aghaeeaval

Introduction and Overview

The 2019 field season was another exceptional one at QUBS. We hosted six undergrad field courses, and welcomed researchers from many different institutions (Queen's, Western, Carleton, Ottawa, Bird Studies Canada). We again had graduate student writing retreats at both Opinicon & the Elbow Lake Environmental Education Centre. We hosted girl guide and boy scout weekends, Queen's University lab retreats, a *Field Entomology for Arborists* workshop, the *Biosphere Youth Environmental Leadership Expedition* and *Fabulous Fall Fungi* workshops. Other events included the *AquaHacking Challenge* weekend expedition for finalists, the *Indigenous Mentorship Network of Ontario Summer Institute*, and the *Matariki Indigenous Student Mobility Program.* We continued to build support for QUBS through donations and grants, and have been seeking funding for new facilities that we desperately need; for our Land Trust to purchase properties for research, teaching, and conservation; and for our QUBS Endowment to ensure long-term financial sustainability.



Staff photo (July 31, 2019). Missing: Mahsa, Rod, EAC staff, Claudia, Gail

QUBS *Research Coordinator*, Dr. Ivana Schoepf, funded by a NSERC RTI Operations and Maintenance grant, dedicated herself to exploring opportunities for new research, organizing training workshops, raising research funds, and promoting QUBS to the broader scientific community. Since her appointment in August 2018, Ivy has worked diligently on many initiatives, including updating our species lists (https://qubs.ca/resources/species-lists), highlighting QUBS at conferences, creating a biannual station newsletter (<u>https://qubs.ca/QUBS_newsletters</u>), fostering new collaborations, and helping to maintain existing or establish new, long-term, monitoring projects, including one on migratory birds.

Data & Collections Manager, Dr. Adriana López-Villalobos, also funded by the NSERC RTI grant, has been working with many undergrad volunteers from Queen's and the QUBS community to digitize our Fowler Herbarium Collection. Volunteers have been pivotal in digitizing the first set of 5,000 vascular plant specimens and taking 5,000 more photographs that have yet to be transcribed. These data will be available through the online portals - *Canadensys* and *GBIF*. Adriana has also been working on cataloguing and augmenting our animal vertebrate collection (road mortalities or birds that have struck windows). Adriana and Ivy helped develop a new, searchable web portal to showcase > 1000 peer-reviewed articles that have been produced by QUBS users based on research at station: <u>https://research.gubs.ca</u>.

Opinicon Operations & Stewardship Manager Aaron Zolderdo and Maintenance Assistant Rod Green, with help from Keith Harper (Queen's, Biology), made many improvements to infrastructure including building new docks at Elbow Lake, installing new floors in Elbow cabins and Phelan Cottage, and renovating two of our original 'bunkies.' We demolished our old aquarium building, and hope that we will soon have sufficient financial support for a new facility with well-equipped labs and teaching spaces. With site-preparations underway, we anticipate that this new facility will be operational by 2022. Aaron began planning for a new *Elbow Lake Fisheries Assessment and Monitoring Program*, and worked with summer interns to upgrade our Queen's Point trails. We were also excited by the wedding of Aaron to Olivia in September at the St. Columbanus church in nearby Elgin. They celebrated their union with friends and family at the QUBS-Opinicon Campus.

Outreach and Teaching Coordinator, Emily Verhoek, oversaw the purchase of additional equipment for QUBS outreach programs with ice fishing rods (*Cabela's Canada Outdoor Fund*) and GPS hand units and geocaches (*Community Foundation of Kingston & Area*). The launch of a new program "*A Day with a Researcher*" was successful with a large turnout to spend a day with Carleton University turtle researcher Dr. Greg Bulté. Spring school visits were a great success and included the highest number of classes to date. Our summer outreach programs ran through July and August and for the first time were offered at both the Elbow Lake and Opinicon campuses. Our Eco-Adventure Camp ran for its 9th year (<u>https://ecoadventurecamp.ca</u>). We facilitated four ORCKA certification and training sessions with QUBS summer staff and Queen's researchers (June 25), Eco-Adventure Camp Leaders in Training (July 3), the Youth Environmental Leadership Expedition (July 9), and Queen's Counselling Service Retreat (June 14). Emily was off on parental beginning in August, after welcoming her second son into her family.

In April, Aaron Zolderdo, Sonia Nobrega, and Emily Verhoek completed their Small Vessel Operator Proficiency (SVOP) training from Miller Marine Training, as mandated by Transport Canada to drive our commercially licenced pontoon boats. In May, we welcomed Adam Morcom as the *Operations and Maintenance Coordinator* of the Elbow Lake Environmental Education Centre. *QUBS Senior Manager,* Sonia Nobrega, planned, monitored, budgeted and ensured that all of these activities at QUBS unfolded smoothly.

In 2019 total user-days exceeded the 10,000 mark again, coming in at 10,704 userdays (user-day data are displayed in Figure 1 and in tabular form on page 22). Overall, use was up ~0.5% over 2018. Approximately 60 researchers (professors, graduate students, undergraduate honours thesis students and assistants) carried out research at QUBS mostly during the spring-summer field season (May through August). We also hosted winter researchers from QUBS Director Dr. Stephen Lougheed's Lab (Queen's University) as well as Dr. Steven Cooke's Lab (Carleton University) in January-March. Research projects and the personnel involved can be found below found in the Research Summaries.

With respect to teaching activities, QUBS hosted 5 modules (2 weeks per module) in the Ontario Universities Program in Field Biology (www.oupfb.ca). Two of these modules were taught by Queen's instructors, with 3 modules led by Carleton University instructors. Jim Ludden (a QUBS alumnus) brought a May field course to QUBS from College of DuPage (Glen Ellyn, Illinois). QUBS also facilitated and hosted a variety of conferences, workshops and meetings in 2019. A detailed list of 2019 field courses, meetings, and workshops offered and hosted at QUBS can be found in the Opinicon Teaching, Meetings and Retreat sections of this report.

In anticipation of our upcoming 75th anniversary we engaged Pinegrove Productions to undertake filming of short videos showcasing QUBS and some of our researchers.



Filming Ivy and Kestrel for upcoming celebratory videos for our 75th anniversary. Photo: S. Nobrega



Figure 1. The data above represents the approximate number of user-days per calendar year. Although QUBS has been in operation since 1945, user-days were not accurately recorded prior to 1983, or between 2011-2015.

Donor Support

As of December 2019, our QUBS Endowment Fund contained \$848,431 and our new Jessie V. Deslauriers QUBS Fund had \$1,800,000.00. In 2013 Jessie donated generously to support the building of a new research and teaching facility, the Jessie V. Deslauriers Centre for Biology, with new dry labs, the Jack Hambleton Library, and the Fowler Herbarium. It is a space much appreciated and used by all who visit QUBS. We were saddened by the Jessie's passing on July 9, 2019, and incredibly grateful for her continued, generous support of QUBS through this endowment fund. Interest from these endowments help with QUBS operations and programming. Contributions from the Lawson Foundation (\$45K/year) continue to underwrite a significant portion of the salary of our *Teaching and Outreach Coordinator* and contribute to programming for young people. Our Land Trust and Community Outreach Fund at year's end totalled \$33,755.75 and \$22,189.54, respectively. Generous support from the *Community Foundation for Kingston & Area* allowed us to develop of the "Navigating the Landscape at Elbow Lake" training workshop.

Queen's University Biological Station Scholarships 2019

Over the last decades the generosity of donors has endowed various scholarships for both Queen's University undergraduate and graduate students. The following individuals were awarded funds to conduct research at QUBS, or to support participation in a field course.

Karen Huntley Memorial Award

Established by family and friends in memory of Karen Huntley, an undergraduate student in Biology who died in May 1990. Awarded to a student in an Honours Biology or an Environmental Science Subject of Specialization (SSP) Biology degree program who will be doing a field course or field research at Queen's University Biology Station or at another site in conservation, environmental biology or sustainable forestry. This award will support expenses incurred at the field site.

Awarded to Shannon Edie (Supervisor: Lougheed)

The Wes and Dorletta Curran Memorial Award For Research in Aquatic Biology This award was established to support undergraduate students who aspire to study at QUBS. Awards will be based on financial need (defined as eligibility for OSAP or other governmental student assistance programs), academic excellence, and full-time enrollment in the Biology undergraduate program at Queen's University. Preference will be given to students doing field or laboratory research in aquatic ecology, illuminating the ecology of the freshwater habitat.

Awarded to Shu Hong Shi (Supervisor: Arnott) and Jennifer Cooke (Supervisor: Blanchfield).

J. Allen Keast Lake Opinicon Undergraduate Research Fellowship For Independent Research at QUBS

This award was established to support undergraduate students to carry out a onesummer study at QUBS. Preference will be given to broader-based studies, such as how systems function or interrelate. Components of the study can fit into on-going longterm studies.

Awarded to Emily Pope (**Supervisor**: Arnott) and Megan Silverthorn (**Supervisor**: Arnott)

The Alexander and Cora Munn Summer Research Award

For Research in Conservation Biology or Environmental Preservation

This award was established to support undergraduate students who are working in the area of conservation biology or environmental preservation at QUBS. Preference will be given to students with an interest in woodlot and wildlife conservation.

Awarded to Meghan Ewing (Supervisor: Lougheed)

The Kingston Field Naturalists' Award

For Research on Conservation Biology or Natural History

The Kingston Field Naturalists' Fund for Queen's University Biological Station was established in spring 2007 in memory of Dr. Robert Stewart, former Head of Microbiology at Queen's University, former KFN President and Honorary President, and former President of the Federation of Ontario Naturalists. The award is intended to benefit and encourage undergraduate students whose studies at QUBS focus on conservation biology or natural history. Recognizing the valuable and unique educational opportunity QUBS provides at a critical stage of a student's development, the KFN established the Fund in keeping with its mandate to stimulate public interest in nature and to acquire and provide knowledge of natural history. The Fund creates opportunities for students with good academic standing and demonstrated leadership skills to gain field experience at QUBS.

Awarded to: Heba Khan (Supervisor: Arnott)



Black-throated blue warbler male. Photo Stephen C. Lougheed

Opinicon Outreach

While <u>Elbow Lake Environmental Education Centre</u> remains the major focus of our outreach activities (see below), we continue to host important outreach events at our Opinicon campus as well.

Opinicon Seminar Series

As always, we had an engaging spring and summer public seminar series with talks on a variety of topics every Wednesday at 7:00 pm in the seminar room at the Raleigh J. Robertson Biodiversity Centre given by graduate students, postdoctoral fellows, professors, and other experts.

Date	Speaker	Talk Title	
01 May	Dr. Chris Elvidge (Carlton University)	Providence lost: Provenance and migratory behaviour of brown trout in Finland	
08 May	QUBS Researchers & Staff	What we do at QUBS	
15 May	Kevin Burke (MSc Candidate, Queen's University)	Patterns of habitat partitioning among coexisting species of Burying Beetles	
15 May	Jamie Bortolotti (MSc Candidate, Queen's University)	Vocal behaviour of closely related bird species	
22 May	Dr. Jacqueline Litzgus (Laurentian University)	The solutions should not cause more problems: Evidence-based science to inform recovery of Species at Risk reptiles	
29 May	Sarena Olson (MSc Candidate, Queen's University)	The maternal effects of avian malaria in red-winged blackbirds	
05 June	Dr. Mike Lawrence (Carlton University)	Does chronic stress mediate predator-prey interactions in wild fish? An experimental approach using exogenous cortisol implants	
12 June	Prof. Robert Longair	Elephant Wasps of Africa: Male Weapons and Intrepid Explorers	
19 June	Dr. Heather Castleden (Queen's University)	Two-Eyed Seeing: An integrative approach for implementing Indigenous and Western systems in environment-health research in Mi'kma'ki	
26 June	Dr. Diane Orihel (Queen's University)	Effects of oil sands chemicals of concern on early life stages of fish and amphibians: Results from outdoor aquatic mesocosm experiments	
03 July	Dr. Shelley Ball (BIOSPHERE Environmental Education)	Why climate change and conservation need photography and filmmaking	
10 July	Scott Siegfried (Natural Resources)	Fort Drum Culvert Replacement Projects Benefit Aquatic Organism Passage	
17 July	Prof. Steve Lukits (Royal Military College)	Look at That! My Best Images from 15 Amazing Years in the QUBS Wilderness	

24 July	Dr. Jannice Friedman (Queen's University)	Ecological genetics of life cycle variation in plants: the seed to succeed across spatial scales
31 July	Dr. Timothy Messner (SUNY Potsdam)	Archaeology of the Adirondack Mountains
07 August	Leanne Greaves (PhD Candidate, University of Western Ontario)	Avian chemosignals: odour-based discrimination of species, sex, and major histocompatibility complex genotype in a songbird
14 August	Lila Colston-Nepali (MSc Candidate, Queen's University)	Using genomic tools to aid conservation of an arctic seabird
14 August	Katie Birchard (MSc Candidate, Queen's University)	Using population genomics to disentangle the Leach's storm-petrel species complex (<i>Hydrobates</i> spp.)
21 August	Liam Harrison (MSc Candidate, Queen's University)	Thermal ecology & plasticity in the burying beetle, <i>Nicrophorus orbicollis</i> : an observational field study
28 August	Danielle Greco (MSc Candidate, Queen's University)	Effects of road salt and nutrients on freshwater zooplankton communities



Meghan Ewing at the QUBS Open House talking about snake research. Photo Stephen C. Lougheed

QUBS Opinicon Open House

On Sunday June 23rd QUBS Open House celebrated its 74th year. This annual event provides an opportunity for people from the surrounding communities to learn more about QUBS research, teaching, outreach and conservation initiatives. This year we welcomed approximately 400 people over the course of the afternoon.

QUBS Community Dinner

On Thursday August 29th our Opinicon campus hosted the 12th Annual Community Dinner. The event was attended by locals, and included a gourmet dinner prepared by our wonderful kitchen staff and a dessert auction featuring delicious home-made cakes. The evening was topped off by a talk by Dr. Steven Cooke, a long-term QUBS researcher from Carlton University, who gave the public an insight into his long-term research in fisheries conservation.

Fabulous Fall Fungi

The Queen's University Biological Station was proud to host the annual Fabulous Fall Fungi workshops for the 10th year running. As in previous years, the 2019 workshops were offered by Richard Aaron (B.A., M.B.A.), a fungi expert and all-round great naturalist, who enthusiastically shared his knowledge with 35 participants. The 2019 workshops were divided into 3 sections of varying length – a 3-day, a 4-day, and a 5day - that took place from late September through early October. The workshops were open to members of the public and aimed to provide insights on the wonderful and very diverse world of mushrooms and other fungi found in Southern Ontario. The workshops were designed to be interactive and hands-on. Morning field trips were undertaken daily to collect specimens from nearby areas and were followed by afternoon classes, where the participants identified the specimens that they had found using reference materials, extensive online resources, hand lenses, and a compound microscope. As well, there was an expert assistant provided at each session to help students with identification. Daily activities were complemented with evening presentations focusing on the natural history, ecology, and uses of fungi. Part of one evening in each session was devoted to looking at bioluminescent fungi and fungi that fluoresce under UV light. Over the course of the three workshop sessions, participants collected and identified a record number of species as compared with previous years, with 112 of these being new for the cumulative list that Richard has been compiling, which now stands at 720 species.

Other Opinicon Outreach Activities

We hosted 8 public events at our Opinicon campus that were attended by 111 participants. This year we added more opportunities for members of the general public to take part in hands-on activities at the station, with several of these family focused. These were a great success and similar events will be continued in future years. Most events were facilitated by our *Outreach and Stewardship Interns* with the assistance of several guest speakers. For attendees of these evening events there was the option to join for dinner before the event. The *Night with the Moth Naturalist* event provided the option to stay overnight in a cabin. These events included:

- Working on Ice Training delivered by Access Rescue Canada (27 February 2019): attended by QUBS staff and 3 additional participants
- A Day with a Turtle Researcher Dr. Grégory Bulté (04 May 2019): 18 participants (sold out, limited capacity of pontoon boats)
- QUBS Bird Banding Workshop Dr. Ivy Schoepf (11 and 18 May 2019): 12 participants
- Night with a Moth Naturalist Richard Aaron (22 June 2019): 12 participants (3 overnight)
- QUBS Family Night Natural History Boat Tour (8 July 2019): 20 participants (sold out, limited capacity of pontoon boats)
- QUBS Family Night Fascinating Fish (22 July 2019): 9 participants
- QUBS Family Night Brilliant Birds (12 August 2019): 28 participants

Infrastructure, Renovations and Maintenance

At Opinicon, a number of maintenance and stewardship projects were completed in 2019. As always, space precludes listing all upgrades here, but the larger projects included the installation of new flooring throughout several office spaces within the Biodiversity Centre as well as within Curran Cottage. The boathouse electrical system was upgraded to match current building code specifications, but also to increase power supply to a new pump system that was needed to support the growing aquatic research interest onsite. Road maintenance was also a key priority this year. In September, we contracted Tackaberry Construction to improve the Queen's University roadway (~1.3 km) beginning at Opinicon Road extending to the Biodiversity Centre. This greatly improved all year-round accessibility not only to the Opinicon Campus, but also to the

homes of our neighbours who share the roadway. We are revitalized the Queen's Point trail system and added a new trail that encircles Cow Island. The trail system has been updated with new directional trail markers as well as a detailed map (<u>https://qubs.ca/resources/maps</u>) to help hikers navigate the new trails. With the help of Dr. Stephen Lougheed's Lab from Queen's University, we also re-opened the Lindsay Lake trail system (on Pangman Conservation Reserve) that has experienced a significant overgrowth of vegetation over the past several years. The Lindsay Lake trail is an essential access trial which has been used for decades to support various teaching and research initiatives.

In addition to infrastructure and stewardship improvements, several new pieces of equipment were purchased in 2019 to support operations, research, and stewardship capabilities including: a new salt/sand spreader for our plow truck, a 7KW propane standby generator to provide back-up power to our aquatic research facilities, as well as a brush saw to aid in trail maintenance needs. For the past several years QUBS has been in need for a versatile work vehicle, one capable of accessing remote areas on the QUBS land base, able to transport heavy gear/equipment to and from research sites, as well as to support basic day-to-day needs both on and off site. To serve this purpose, we were able to purchase a used work truck this past March, a 2010 Chevrolet Silverado 1500. This is a welcome addition to the QUBS fleet of vehicles.

In October we decommissioned and demolished our Aquarium facility at our Opinicon Campus (Figure 2). Demolishing this building is a first step in site preparation for a new Conservation Research and Teaching Building that will not expand and modernize our aquarium facility but will also include a molecular lab, conference and teaching spaces with broadcast quality audiovisual equipment, a new GIS laboratory and work centre, and new office spaces for students and researchers. The old Aquarium building, which was built in the 1970's, was showing its age and no longer provided safe working conditions for researchers nor met current animal care standards. However, this facility was essential in supporting decades of aquatic research. While in operation, many scientific discoveries were achieved ranging from understanding the fundamental reproductive biology of fishes to methods to improve best-handling practises associated with recreational fisheries. Collectively, these studies have helped to shape past, and current, fisheries management practises. Although the old Aquarium building will be missed, the creation of the new Conservation Building is needed and will facilitate the next generation of aquatic research and discovery.

We were excited to see the start of construction of the CFI-funded infrastructure that Dr. Diane Orihel (Department of Biology and School of Environmental Studies, Queen's University) on the QUBS land base in autumn. The *Queen's Experimental Ecology and Ecotoxicology (QE3) Research Living Lab* will be established near Warner Lake on the Hughson Tract, and will support research seeking to understand the effects of chemical pollutants on freshwater ecosystems.

In 2019, we also undertook several improvements at Elbow Lake. Roadways were maintained with new gravel and grading completed. Many of the wooden docks and decks at Elbow Lake were repaired to ensure the safety of all users. We continue to remove carpets from cabins, and replace them with new flooring (pine or vinyl) as funds are available, with cabin fridges and mattresses also replaced as needed. Many of the Elbow Lake roofs have been updated and replaced with shingles by contract roofers. This work was begun in October 2018 and completed in May of this year. We replaced the shingles on cabins 1, 2, 4, the Staff Cabin, the Main Pavilion and the manager's house. The old shingle roofs of the Nature Centre and Garage were replaced with steel.



Figure 2: Aquarium building being demolished October 30th, 2019 by French's Trucking and Construction. The building was demolished, and debris hauled away in less than 6 hours! Photo Aaron Zolderdo.

Opinicon Teaching

OUPFB and Other Field Courses

Every year QUBS hosts a number of field courses, not only for Queen's University students, but also for undergraduates and graduates from other Canadian and international institutions.

- Fish Ecology & Fisheries: The Science Behind Conservation and Management (April 28th May 11th), instructed by Dr. Chris Elvidge (Carleton University)
- Turtles: Ecology, Behaviour, and Conservation (May 5th May 18th), instructed by Dr. Greg Bulté (Carleton University)
- Canadian Scientific Research Diving (July 19th August 4th), instructed by Dr. Nigel Waltho (Carleton University)
- Effects of human development on aquatic environments and biodiversity in Canada and China (July 28th – August 10th, 2019), instructed by Drs. Stephen Lougheed and Yuxiang Wang (Queen's University)
- Field Ecology (August 17th August 30th), instructed by Dr. Robert Montgomerie (Queen's University)



Other Field Courses

- General Ecology Field Course (May 20th May 25th), instructed by James Ludden (College of DuPage, IL, USA). The 17th consecutive year of course at QUBS.
- Field Entomology for Arborists (August 12th 15th), instructed by Marvin Gunderman (McMaster University, retired), Jennifer Llewellyn (Provincial Nursery and Landscape Specialist, OMAFRA), David Cheung (Entomologist, Educator, Photographer and Designer with DKB Digital Designs)
- Youth Environmental Leadership Expedition program (July 1st July 14th), instructed by Shelley Ball (Founder/President, Biosphere Environmental Education)
- Working on Ice Safety Training Program (February 27th 28th), instructed by Steve Dias (Access Rescue Canada; <u>https://accessrescuecanada.org</u>)

Field Trips for Lecture-based Courses and Other Teaching Activities

Carleton University

 Environmental Science Field Methods course (October 4th – 6th), led by instructors Richard Amos and Jake Brownscombe (Carleton University), 5th consecutive year.

Queen's University:

- BIOL 212 Scientific Methods in Biology (September 21st & 28th), led by instructor Anna Rooke (Queen's University)
- BIOL 300 Ecology (September 21st 22nd, and 27th 28th), led by Instructors Drs. Laura Nagel and Paul Martin (Queen's University)
- BIOL 335 Limnology & Aquatic Ecology (September 28th 29th, & October 5th 6th), led by instructor Dr. Paul Grogan
- GEOG 415 & 841 Advanced Analysis of Earth Surface Processes (September 28th 29th), led by Drs. Melissa Lafreniere and Laura Thomson (Queen's University)



BIOL330 class excursion to QUBS. Photo: S. Nobrega

Opinicon Conferences, Meetings and Retreats

- Opeongo High School Field Trip (May 1st 3rd), coordinated by QUBS alumnus Tim Demmons (Opeongo Highschool)
- Queen's University, Event for New Faculty (June 1st), coordinated by Jacquie Jamieson, Lauren Sharpe, & Jill Philips (Queen's University)
- Indigenous Mentorship Network of Ontario Summer Institute (June 16th 20th) coordinated by Heather Castleden (Queen's University)
- Canadian Institute of Ecology and Evolution (CIEE/ICEE) Mathematics and Statistics Conference (June 28th), coordinated by Felicia Magpantay (Queen's University)
- PICO Dark Matter Experimental Collaboration Meeting (August 20th 23rd), coordinated by Dr. Tony Noble (Queen's University)
- The Lake Shift, thesis writing retreat for Ontario doctoral students (July 14th 19th), coordinated by Colette Steer (Queen's University)

- Wedding Reception for Aaron & Olivia Zolderdo (September 7th)
- Carleton University Post-Doc Writing Retreat (October 7th 8th), coordinated by Joseph Bennett and Steven Cooke (Carleton University)



Halloween pennant. Photo Stephen C. Lougheed

Elbow Lake Environmental Education Centre

We hosted 61 education events, 19 of which were open to the public. We had 1692 participants, 1286 of which were youth. The Lawson Foundation provided support for our environmental and outreach coordinator position and for the purchase of outreach materials. The Community Foundation of Kingston provided support for winter program materials and busing subsidies.

We hosted many successful public events this year including our Family Ice Fishing event that brought 135 participants for a beautiful sunny day on the lake. We also continued our Family Night events throughout July and August with 81 attendees to our 7 events. Thirty families (14 of which were camp families) took part in our overnight option for Family Night and stayed in one of our cabins after the evening program. There has been increased use of the facilities by community groups and public rentals including returning groups such as Kingston Indigenous Language Nest (KILN), Wise Women, AquaHacking Expeditions, Dissertation on the Lake, Ontario Women Anglers, Aboriginal Teacher Education Program (ATEP) land-based classes, and department and lab graduate student retreats. We welcomed many new groups such as the Kahwa:tsire Journey Together (Early-On playgroup), bringing an Indigenous component that focuses on language and culture. They visited Elbow on 4 dates. The McDonald Institute also had a day retreat at Elbow Lake.

ELEEC Outreach Activities

Eco-Adventure Camp

Camp staff: Director- Ruth Bryce, Assistant Director- Emma Crivello, Counsellors-Sarah Reddick, James Feschuk, Nestor Grandal. There were 135 regular campers and 11 Leaders in Training. We provided 7 bursaries, and 14 camp families attend the weekly public family nights events hosted in July and August.

Secondary School Visits

We had 31 school groups attend from 16 different schools. In total we hosted 938 students and 73 teachers.

Other ELEEC Outreach Activities

- Faculty of Education (30 January 2019): 46 participants
- Family Ice Fishing (17 February 2019): 135 participants
- Kingston Junior Field Naturalists (09 March 2019): 10 participants
- Enrichment Studies Unit @Queen's (06 May 2019): 32 participants
- Kingston Brownies (25 May 2019): 30 participants
- Girl Guides (15 June 2019): 14 participants
- Family Fishing Day (07 July 2019): 50 participants
- Elbow Family Night- Canoeing (11 July 2019): 7 participants
- Elbow Family Night- Reptiles (18 July 2019): 6 participants

- Elbow Family Night- Birds (25 July 2019): 8 participants
- Elbow Family Night- Frogs (01 August 2019): 17 participants
- Elbow Family Night- Stars (09 August 2019): 32 participants
- Queen's School of English (13 August 2019): 33 participants
- Enrichment Studies Unit @Queen's (15 August 2019): 39 participants
- Elbow Family Night- Lake (15 August 2019): 5 participants
- Queen's School of English (16 August 2019): 59 participants
- Elbow Family Night- Paddle (22 August 2019): 6 participants
- Ottawa Home School Group (05 September 2019): 14 participants
- Brownies (26 October 2019): 21 participants



Loughborough Public School. Grades 1 and 4. Snow shoeing. Photo. E. Verhoek

Table 1: Categorical breakdown of User-Day statistics for both Opinicon and Elbow lake campuses.

2019 QUBS User-Day Statistics			
DAY-USE TYPE	Total		
Research (Internal, Queen's)	1559		
Research (External)	1443		
Teaching Activities	925		
Conferences, Meetings, Workshops (Opinicon)	1372		
Conferences, Meetings, Workshops (Elbow)	2129		
OUTREACH			
Programs (Opinicon)	736		
Programs (Elbow)	1696		
Campers & LIT's (Elbow)	300		
Miscellaneous	393		
Total User-Days	10523		



Snapping turtle female. Photo Stephen C. Lougheed

Opinicon Research Summaries

Lonnie Aarssen (Biology, Queen's University)

Research projects:

- 1. Effects of long-term resource manipulation in old-field vegetation
- 2. Long-term vegetation monitoring in woodland deer exclosures
- 3. Relationships between plant traits, fitness and abundance in vegetation

Funding: NSERC Discovery Grant

Students and field assistants:

- 1. Jenna Finley (M.Sc. candidate, Queen's University)
- 2. Cassandra Pereira (field assistant, Queen's University)
- 3. Zoe Kane (field assistant, Queen's University)

Undergraduate theses:

- 1. Garland E (B.Sc. awarded in 2019) Thesis research evaluates the potential relationship between the average leaf area of a species and its abundance ranking for species within Kingston and surrounding area.
- 2. Pereira C (B.Sc. awarded in 2019) working towards understanding how clonality contributes to size, recruitment, and fecundity responses within local grass species.

Graduate theses:

Finley JV (M.Sc. in progress) Do species with strong apical dominance incur a cost in terms of suppressed potential fecundity or biomass?

Published articles based on work conducted at QUBS:

- Tracey A, Aarssen L (2019) Resident species with larger size metrics do not recruit more offspring from the soil seed bank in old-field meadow vegetation. *Journal of Ecology* **107**, 1067-1078
- 2. Serafini J, Grogan P, Aarssen L (2019) Summer precipitation limits plant species richness but not overall productivity in a temperate mesic old-field meadow. *Journal of Vegetation Science* **30**, 832-844.

Shelley A. Arnott (Biology, Queen's University)

Research projects:

- 1. Effects of increased turbidity on freshwater zooplankton communities
- 2. The effects of recreational watercraft decontamination on reducing the overland dispersal of aquatic invasive species
- 3. Examining zooplankton community responses to sequential multiple environmental stressors: How prior exposure and timing of exposure influence responses to high salinity and acute thermal stressors

Funding: NSERC

Students and field assistants:

- 1. Xinyu Sun (Ph.D candidate, Queen's University)
- 2. Shrisha Mohit (M.Sc candidate, Queen's University)
- 3. Katrina Cantera (M.Sc candidate, Queen's University)
- 4. Shuhong Shi (B.Sc candidate, Queen's University)
- 5. Emily Pope (B.Sc candidate, Queen's University)
- 6. Heba Khan (B.Sc candidate, Queen's University)

Undergraduate theses:

None in 2019

Graduate theses:

- 1. Sun X (Ph.D in progress) Thesis work examines how different sequence and time intervals of two sequential stressors (i.e. acute thermal stress and high chloride ion concentration) influence zooplankton community dynamics, such as species composition and biomass.
- 2. Mohit S (M.Sc in progress) Thesis work focuses on preventing the overland dispersal of aquatic invasive species
- 3. Cantera K (M.Sc. in progress) Effects of increased turbidity on freshwater zooplankton communities

Published articles based on work conducted at QUBS:

Mohit S, Johnson TB, Arnott SE (2021) Recreational watercraft decontamination: can current recommendations reduce aquatic invasive species spread? *Management of Biological Invasions*. In press.

Ian Fife (Bird Studies Canada)

Research projects:

Cerulean warbler abundance and habitat preferences across southern Ontario

Funding: NA

Students and field assistants:

- 1. Ian Fife (Research technician, Bird Studies Canada)
- 2. Sean Jenniskens (Research technician, Bird Studies Canada)

Undergraduate theses:

None in 2019

Graduate theses:

None in 2019

Published articles based on work conducted at QUBS:

None in 2019

Gabriel Blouin-Demers (Biology, University of Ottawa)

Research projects:

Conservation of reptiles throughout the Ridaeu Waterway system

Funding: NA

Students and field assistants:

- 1. Audrey Turcotte (Ph.D candidate, University of Ottawa)
- 2. Max Henry-Adams (B.Sc candidate, University of Ottawa)
- 3. Raphael Siegel (B.Sc candidate, University of Ottawa)

Undergraduate theses:

None in 2019

Graduate theses:

Turcotte A (Ph.D. in progress) Evaluating how lock systems and boat activity influence the genetic structure of turtle populations throughout the Rideau Waterway system

Published articles based on work conducted at QUBS:

- Bulté G, Léveillée MB, Blouin-Demers G, Cooke SJ, Bertram SM (2020) Observations on the short-term effects of motorboat disturbance on the use of basking sites by female northern map turtles. *Chelonian Conservation and Biology*, in press.
- Larocque SM, Lake C, Midwood JD, Nguyen VM, Blouin-Demers G, Cooke SJ (2020) Freshwater turtle bycatch research supports science-based fisheries management. Aquatic Conservation: Marine and Freshwater Ecosystems **30**, 1783-1790.
- 3. Capkun-Huot C, Fyson VK, Blouin-Demers G (2021) Landscape composition predicts the local abundance of painted turtles (*Chrysemys picta*). *Herpetology Notes*, **in press**.

Fran Bonier (Biology, Queen's University)

Research projects:

- 1. The effects of malarial infection in red-winged blackbirds
- 2. The thermal ecology of Nicrophorus beetles

Funding: NSERC

Students and field assistants: None at QUBS in 2019

None in 2019.

Undergraduate theses:

None in 2019.

Graduate theses:

- 1. Harrison L (M.Sc. in progress) Describing the natural thermal ecology of a burying beetle: *Nicrophorus orbicollis.*
- 2. Olson S (M.Sc. awarded in 2019) The maternal effects of avian malaria in red-

winged blackbirds.

3. Ong JY (M.Sc. awarded in 2019) Coping with thermal challenges: family reaction norms of life history traits in a burying beetle with biparental care.

Published articles based on work conducted at QUBS:

- 1. Cox AR, Robertson RJ, Lendvai AZ, Everitt K, Bonier F (2019) Rainy springs linked to poor nestling growth in a declining avian aerial insectivore (*Tachycineta bicolor*). *Proceedings of the Royal Society B* **286**, 20190018.
- 2. Montreuil-Spencer C, Schoenemann K, Lendvai AZ, Bonier F (2019) Winter corticosterone and body condition predict breeding investment in a nonmigratory bird. *Behavioral Ecology* **30**, 1642-1652.
- Schoenle LA, Moore IT, Dudek AM, Garcia EB, Mays M, Haussmann MF, Cimini D, Bonier F (2019) Exogenous glucocorticoids amplify the costs of infection by reducing resistance and tolerance, but effects are mitigated by co-infection. *Proceedings of the Royal Society B* 286, 1900.

Grégory Bulté (Biology, Carleton University)

Research projects:

Reproductive behaviours of freshwater turtles

Funding: NA

Students and field assistants:

Rowan Brzezinski (B. Sc Student, Carleton University)

Undergraduate theses:

Brzezinski R (B. Sc Student) Assessing mate choice behaviour in map turtles

Graduate theses:

None in 2019

Published articles based on work conducted at QUBS:

Feng W, Bulté G, Lougheed SC (2019) Environmental DNA surveys help to identify winter hibernacula of a temperate freshwater turtle. *Environmental DNA* **2**, 200-209.

Vincent Careau (Biology, University of Ottawa)

Research projects:

Functional ecology of white-footed mice

Funding:

- 1. Discovery Grant from NSERC
- 2. Tier 2 Canada Research Chair in Functional Ecology

Students and field assistants:

- 1. Alyssa Fieldler (M.Sc. candidate, University of Ottawa)
- 2. Merlin Caron-Levesque (Ph.D candidate, University of Ottawa)
- 3. Natalie Kermany (M.Sc candidate, University of Ottawa)
- 4. Rachel Bergeron (B.Sc candidate, University of Ottawa)

Undergraduate theses:

None in 2019

Graduate theses:

- 1. Fieldler A (M.Sc. in progress) The relationship between basal and maximal metabolic rates in white-footed mice, *Peromyscus leucopus*
- 2. Kermany N (M.Sc awarded in 2019) Worked on the behavioural ecology of whitefooted mice
- 3. Caron-Levesque (Ph.D in progress) Works on the energetic trade-offs associated with parasitism in white-footed mice

Published articles based on work conducted at QUBS:

Berberi I, Careau V (2019) Performance trade-offs in wild mice. Oecologia 191, 11-23.

Robert Colautti (Biology, Queen's University)

Research projects:

Genotype-by-environment interactions in the impact of garlic mustard (Alliaria petiolata)

Funding: NSERC

Students and field assistants:

- 1. Claire Smith (B.Sc. candidate, Queen's University)
- 2. Mia Marcellus (B.Sc. candidate, Queen's University)
- 3. Evelyn Newman (B.Sc. candidate, Queen's University)
- 4. Richie Honor (M.Sc candidate, Queen's University)

Undergraduate theses:

- 1. Smith C (B.Sc. in progress) Evolution and ecology of purple loosestrife
- 2. Marcellus M (B.Sc. in progress) Genetic variation and plasticity of garlic mustard (*Alliaria petiolata*) in invasive North American populations
- 3. Newman E (B.Sc. in progress) The evolution of flowering time and resistance to a specialist herbivore in invasive North American populations of purple loosestrife (*Lythrum salicaria*) and herbivory

Graduate theses:

Honor R (M.Sc in progress) Evolutionary processes linked to plant invasions

Published articles based on work conducted at QUBS:

None in 2019

Steven J. Cooke (Biology & Environmental Science, Carleton University)

Research projects:

- 1. Evaluation of the costs of predation in wild centrarchid fish (black bass and sunfish)
- 2. Examination of the effects of light pollution on wild fish.
- 3. Evaluation of the spatial ecology of wild fish in the Rideau Canal waterway.

4. AquaTrax Learning: A free, curriculum-based resource for teaching that brings the movement of wild animals into classrooms across Canada

Funding: NSERC, NSERC PromoScience

Students and field assistants:

- 1. Christine Madliger (Post-Doctoral Fellow, Carlerton University)
- 2. Ben Hlina (Ph.D. candidate, Carleton University)
- 3. Mike Lawrence (Ph.D. candidate, Carleton University)
- 4. Aaron Zolderdo (Ph.D. candidate, Carleton University)
- 5. Alice Abrams (Ph.D. candidate, Carleton University)
- 6. Tanya Prystay (M.Sc. candidate, Carleton University)
- 7. Jason Charlebois (M.Sc. candidate, Carleton University)
- 8. Brooke Etherington (B.Sc. candidate, Carleton University)
- 9. Danny Glassman (B.Sc. candidate, Carleton University)
- 10. Auston Chor (B.Sc. candidate, Carleton University)

Undergraduate theses:

- 1. Etherington B (B.Sc. in progress) Evaluating the impacts of light pollution on the fish physiology
- 2. Glassman D (B.Sc. in progress) Using baited underwater camera stations to survey fish populations
- 3. Chor A (B.Sc. in progress) Using accelerometers to quantify post-release movement behaviour in freshwater fish species

Graduate theses:

- 1. Abrams A (Ph.D. in progress) Black bass tournament science biological and human dimensions.
- 2. Lawrence M (Ph.D. awarded in 2019) Physiology of fish predation
- 3. Zolderdo A (Ph.D. in progress) Consequences of aquatic protected areas on the physiological ecology and behaviour of wild fish in collaboration with Dr. Cory Suski from University of Illinois

Published articles based on work conducted at QUBS:

- Gallagher AJ, Lawrence MJ, Jain-Schlaepfer SMR, Gilmour KM, Wilson ADM, Cooke SJ (2019) Effects of predator exposure on baseline and stress-induced glucocorticoid hormone concentrations in pumpkinseed *Lepomis gibbosus*. *Journal* of Fish Biology 95, 969-973.
- 2. Lawrence MJ, Zolderdo AJ, Godin JGJ, Mandelman JW, Gilmour KM, Cooke SJ (2019) Cortisol does not increase risk of mortality to predation in juvenile bluegill

sunfish: A manipulative experimental field study. *Journal of Experimental Zoology* **331**, 253-261.

- 3. Lawrence MJ, Godin JGJ, Zolderdo AJ, Cooke SJ (2019) Chronic plasma cortisol elevation does not promote riskier behaviour in a teleost fish: A test of the behavioural resiliency hypothesis. *Integrative Organismal Biology* **1**, obz009.
- 4. Lawrence MJ, Eliason EJ, Zolderdo AJ, Lapointe D, Best C, Gilmour KM, Cooke SJ (2019) Cortisol modulates metabolism and energy mobilization in wild-caught pumpkinseed (*Lepomis gibbosus*). *Fish Physiology and Biochemistry* **45**,1813-1828.
- Prystay TS, Lawrence MJ, Zolderdo AJ, Brownscombe JW, de Bruijn R, Eliason EJ, Cooke SJ (2019) Exploring relationships between cardiovascular activity and parental care behavior in nesting smallmouth bass: A field study using heart rate biologgers. *Comparative Biochemistry and Physiology* 234, 18-27.
- 6. Pullen CE, Arlinghaus R, Lennox RJ, Cooke SJ (2019) Telemetry reveals the movement, fate, and lure-shedding of northern pike (*Esox lucius*) that break the line and escape recreational fisheries capture. *Fisheries Research* **211**, 176-182.
- Zolderdo AJ, Abrams AEI, Reid CH, Suski CD, Midwood JD, Cooke SJ (2019) Evidence of fish spillover from freshwater protected areas in lakes of eastern Ontario. *Aquatic Conservation: Marine and Freshwater Ecosystems* 29, 1106-1122.

* Roslyn Dakin (Biology, Carleton University)

Research projects:

Avian flight behaviour and insectivory

Funding: NSERC

Students and field assistants:

Roslyn Dakin (PI, Carleton University)

Undergraduate theses:

None in 2019

Graduate theses:

None in 2019

Published articles based on work conducted at QUBS:

None in 2019

Elizabeth Gow (Integrative Biology, University of Guelph)

Research projects:

Estimating densities and occupancy of free-roaming cat populations in relation to bird species abundance

Funding: Liber Ero

Students and field assistants:

Elizabeth Gow (Post-doctoral researcher, University of Guelph)

Undergraduate theses:

None in 2019

Graduate theses:

None in 2019

Published articles based on work conducted at QUBS:

None in 2019

Paul Grogan (Biology, Queen's University)

Research projects:

Interaction of simulated atmospheric nitrogen deposition and soil texture on plant productivity in Ontario hay grasslands

Funding: NSERC

Students and field assistants:

Mike Hann (Undergraduate student, Queen's University)

Undergraduate theses:

Hann M (B.Sc. in progress) Effects of Experimentally Altered Precipitation and NPK Fertilization on Soil Ammonium, Nitrate, and Phosphate Fluxes in a Mesic Old-field Meadow Grassland

Graduate theses:

None at QUBS in 2019

Published articles based on work conducted at QUBS:

None at QUBS in 2019

Manisha Kulkarni (Biology, University of Ottawa)

Research projects:

Landscape ecology of deer ticks and its associated lyme disease pathogen in periurban environments

Funding: NSERC

Students and field assistants:

- 1. Roman Mckay (research technician, University of Ottawa)
- 2. Benoit Talbot (Post-doctoral research fellow, University of Ottawa)
- 3. James Logan (Ph.D candidate, University of Ottawa)
- 4. Andreea Slatculescu (Ph.D candidates, University of Ottawa)

Undergraduate theses:

None in 2019

Graduate theses:

- Logan J (Ph.D in progress) Thesis work investigates emerging vector-borne disease epidemiology and the impacts of geographic variance on risk of vector-borne disease exposure
- 2. Slatculescu A (Ph.D in progress) Thesis work investigates the molecular and spatial

epidemiology of Lyme disease emergence in Eastern Ontario.

Published articles based on work conducted at QUBS:

Slatculescu AM, Clow KM, McKay R, Talbot B, Logan JJ, Thickstun CR, Jardine CM, Ogden NH, Knudby AJ, Kulkarni MA (2020) Species distribution models for the eastern blacklegged tick, Ixodes scapularis, and the Lyme disease pathogen, *Borrelia burgdorferi*, in Ontario, Canada. *PLOS ONE*. **In Press**.

Stephen C. Lougheed (Biology & Environmental Studies, Queen's University)

Research projects:

- 1. Using environmental DNA (eDNA) to map the distribution of Common Musk Turtle (*Sternotherus odoratus*) in Eastern Ontario
- 2. Efficacy of various conservation strategies for a threatened population of Gray Ratsnakes (*Pantherophis spiloides*)

Funding: NSERC Discovery and MTO

Students and field assistants:

- 1. Wenxi Feng (Ph.D. candidate, Queen's University)
- 2. Ying Chen (M.Sc. candidate, Queen's University)
- 3. Mathew Macpherson (M.Sc. candidate, Queen's University)

Undergraduate theses:

None in 2019

Graduate theses:

- 1. Feng W (Ph.D. in progress) eDNA approaches to quantifying species distributions
- 2. Chen Y (M.Sc. in progress) Reproductive behaviour and genetics of spring peeper
- Macpherson M (M.Sc. in progress) Evaluating conservation strategies for a Threatened population of Gray Ratsnake (*Pantherophis spiloides*) - Co-supervised with Jackie Litzgus (Laurentian University)

Published articles based on work conducted at QUBS:

Feng W, Bulté G, Lougheed SC (2019) Environmental DNA surveys help to identify winter hibernacula of a temperate freshwater turtle. *Environmental DNA* **2**, 200-209.

Elizabeth A. MacDougall-Shackleton (Biology, Western University)

Research projects:

Does the preen-gland microbiome mediate chemical signalling in songbirds?

Funding: NSERC Discovery Grant and NSERC Discovery Accelerator Supplement

Students and field assistants:

- 1. Chris Posliff (M.Sc. candidate, University of Western Ontario)
- 2. Garth Casbourn (Ph.D candidate, University of Western Ontario)
- 3. Rebecca Howe (B.Sc candidate, University of Western Ontario)
- 4. Nanxi Huang (B.Sc candidate, University of Western Ontario)

Undergraduate theses:

None at QUBS in 2019

Graduate theses:

- 1. Casbourn G (Ph.D. in progress) Examining how steroid hormones and infection by malaria parasites are associated with large- and short- range movements in migratory songbirds
- 2. Posliff C (M.Sc. in progress) Movement syndromes over multiple spatial scales: migration distance and exploratory behaviour in song sparrows
- 3. Howe R (M.Sc in progress) Effects of malarial infection on migratory timing and restlessness.

Published articles based on work conducted at QUBS:

1. Grieves LA, Bernards MA, MacDougall-Shackleton EA (2019) Behavioural responses of songbirds to preen oil odour cues of sex and species. *Animal Behaviour* **156**, 57-65.

- 2. Grieves LA, Bernards MA, MacDougall-Shackleton EA (2019) Wax ester composition of songbird preen oil varies seasonally and differs between sexes, ages, and populations. *Journal of Chemical Ecology* **45**, 37-45.
- 3. Kelly TR, Hobson KA, Casbourn GW, MacDougall-Shackleton EA, MacDougall-Shackleton SA (2019) Long-term winter-site fidelity in Song Sparrows (*Melospiza melodia*). *The Auk* **136**, ukz010.
- 4. Slade JWG, Watson MJ, MacDougall-Shackleton EA (2019) "Balancing" balancing selection? Assortative mating at the major histocompatibility complex despite molecular signatures of balancing selection. *Ecology and Evolution* **9**, 5146-5157.

Paul Martin (Department of Biology, Queen's University)

Research projects:

Ecological and behavioural interactions among closely related species:

- 1. Carrion beetles
- 2. Signal divergence in birds
- Interactions among closely related songbirds collaboration with Dan Mennill (University of Windsor)
- 4. Habitat use and breeding populations of birds collaboration with Paul Treitz (Geography, Queen's University)

Funding: NSERC

Students and field assistants:

- 1. Kevin Burke (M.Sc. awarded in 2019, Queen's University)
- 2. Adam Groulx (Ph.D candidate, Queen's University)
- 3. Samreen Musim (M.Sc candidate, Queen's University)

Undergraduate theses:

None in 2019

Graduate theses:

1. Groulx A (Ph.D. in progress) Role of trade-offs in functional traits in structuring communities of related species.

- 2. Burke K (M.Sc. awarded in 2019) Mechanisms of Habitat Partitioning in *Nicrophorus* Burying Beetles.
- 3. Musim S (M.Sc in progress) Thesis work explores how New World sparrow species breed on the rocky outcrops of the Frontenac Arch.

Published articles based on work conducted at QUBS:

Wettlaufer JD, Burke KW, Schizkoske A, Beresford DV, Martin PR (2018) Ecological divergence of burying beetles into the forest canopy. *PeerJ* **6**:e5829

Strain D. Neff (Biology, Western University)

Research projects:

Evolutionary ecology of sunfish

Funding: NSERC Discovery; NSERC RTI

Students and field assistants:

- 1. Churchman E (M.Sc. candidate, University of Western Ontario)
- 2. Ashley Watt (Field assistant, University of Western Ontario)
- 3. Dr. Tim Hain (Field assistant, University of Western Ontario)
- 4. Erin Ingolsdby (B.Sc Candidate, University of Western Ontario)
- 5. Amanda Nurse (B.Sc Candidate, University of Western Ontario)

Undergraduate theses:

Nurse A (B.Sc in progress) thesis work involved manipulating sex hormones in reproductive sunfish to evaluate proximate mechanism influence that may influence parental care

Graduate theses:

Churchman E (M.Sc. in progress) Neuroendocrinology of sunfishes during the reproductive period.

Published articles based on work conducted at QUBS:

Cunha AAP, Partridge CG, Knapp R, Neff BD (2019) Androgen and prolactin manipulation induces changes in aggressive and nurturing behavior in a fish with male

parental care. Hormones and Behavior 116, 104582.

Diane Orihel (Biology, Queen's University)

Research projects:

Evaluating how embryonic development in fathead minnows is affected by exposure to naphthenic acid fraction components.

Funding: Queen's Research Opportunities Fund, Environment and Climate Change Canada

Students and field assistants:

- 1. Jessie Reynolds (M.Sc candidate, Queen's University)
- 2. Brianna Jackson (B.Sc candidate, Queen's University)
- 3. Elisa Lopez (B.Sc candidate, Queen's University)

Undergraduate theses:

- Jackson B (B.Sc in progress) Thesis work investigates the cardiotoxicity of naphthenic acid fraction components from oil sands process-affected water on developing fathead minnow (*Pimephales promelas*)
- 2. Lopez B (B.Sc awarded in 2019) Thesis work quantified the effect of naphthenic acid fraction components on larval *Pimephales promelas* performance and growth

Graduate theses:

Reynolds J (M.Sc in progress) Thesis work evaluates the effects of oil sands contaminants on the physiology and behaviour of fathead minnow

Published articles based on work conducted at QUBS:

None at QUBS in 2019

David Philipp (Illinois Natural History Survey, University of Illinois)

Research projects:

Evaluating historical trends in black bass reproduction and population numbers

Funding: Fisheries Conservation Foundation (CFC)

Students and field assistants:

Jigme Tsuendrup (Field assistant, Bhutan Fisheries Management)

Undergraduate theses:

None at QUBS in 2019

Graduate theses:

None at QUBS in 2019

Published articles based on work conducted at QUBS:

None at QUBS in 2019



Cow Island Marsh in winter. Photo Stephen C. Lougheed