

Queen's University Biological Station Annual Report 2015



Director: Dr. Stephen C. Lougheed
Associate Director: Dr. Shelley A. Arnott

Manager: Frank Phelan
Assistant Manager: Andrew Rodmell

Elbow Lake Environmental Education Centre Manager: Carolyn Bonta

Table of Contents

INTRODUCTION AND OVERVIEW	3
DONOR SUPPORT	4
QUEEN’S UNIVERSITY BIOLOGICAL STATION SCHOLARSHIPS 2015	5
OPINICON OUTREACH	6
OPINICON SEMINAR SERIES	6
QUBS OPEN HOUSE AND LIBRARY OPENING.....	8
QUBS COMMUNITY DINNER	9
FABULOUS FALL FUNGI	10
OTHER OPINICON OUTREACH ACTIVITIES.....	11
INFRASTRUCTURE, RENOVATIONS AND MAINTENANCE	11
OPINICON TEACHING	13
OUPFB AND OTHER FIELD COURSES	13
<i>Ontario University Program in Field Biology</i>	13
<i>Other Field Courses</i>	14
FIELD TRIPS FOR LECTURE-BASED COURSES	14
OPINICON CONFERENCES, MEETINGS AND RETREATS	15
OPINICON RESEARCH SUMMARIES	16
ELBOW LAKE ENVIRONMENTAL EDUCATION CENTRE	36
OVERVIEW	36
ELEEC OUTREACH ACTIVITIES.....	36
<i>ELEEC Open House</i>	36
<i>Elbow Lake Trail Guide Interpretive App</i>	37
<i>Eco-Adventure Camp</i>	37
<i>Secondary School Visits</i>	38
<i>Other ELEEC Outreach Activities</i>	38
<i>Update on Stewardship</i>	39

Cover image: White-breasted nuthatch at the Elbow Lake Environmental Education Centre. Photo by S.C. Lougheed.

Introduction and Overview

The year 2015 was busy with many undergraduates experiencing QUBS firsthand in courses and for research for their undergraduate theses, intensive research activity undertaken by researchers from many institutions, and myriad outreach activities at both the Elbow Lake Environmental Education Centre and our main Opinicon campus.

We also celebrated our 70th year of operation with a well-attended Open House on Sunday June 28th 2015, and on the same day, the grand opening of the Jessie V. Deslauriers Centre for Biology.

Our ties to Chinese partner institutions continue to deepen. In July we hosted the Queen's-Tongji Sino-Canada Workshop for Aquatic Environmental Sustainability and Development. The workshop provided an opportunity to launch a new 'sister station' relationship between QUBS and the Yangtze Environmental Specimen Bank in Jiaying, Zhejiang province. In July we also hosted a delegation from Beijing Normal University, which has a strong ecology program and a network of field stations.

We celebrated Manager Frank Phelan's 40 years of service to the Queen's University Biological Station and Queen's University in November. Frank retired at the end of December 2015 and we wish him well, although he has assured us that he will continue to aid us as we work to ensure QUBS' future and expand its programs.



Frank Phelan receiving his retirement gift, a custom made fly fishing rod by rod-maker Andy Snedden. Photo by Brian Cumming.

Donor Support

Over the last decade we have been building a QUBS Endowment Fund, the proceeds from which are intended to support all facets of QUBS operations including programming and research, but also to help ensure financial sustainability over the longer term. Examples of items that the Endowment Funds could be used for include:

- Supporting additional outreach or teaching staff.
- Reducing our ecological footprint and energy usage with green initiatives,
- Engaging in more effective stewardship of our increasing landholdings,
- Addressing important deferred maintenance, and
- Upgrading to QUBS facilities and equipment.

Ultimately, we hope this fund will allow QUBS to achieve its full potential as one of the world's premier field stations. Using the interest we have purchased more energy efficient appliances and a new efficient composter, acquired remote sensing data for researchers and students, and helped to stabilize price increases for users.

As of February 2016 the balance of this fund was \$612,555 Canadian.

In addition to the Endowment Fund, and aside from existing QUBS student scholarships (see below), we have two other major funds. Our Land Trust Fund provides monies for stewardship of existing lands and provides funds to acquire priority properties that might become available (increasingly in partnership with the Nature Conservancy of Canada). The balance of the Land Trust now sits at \$89,606. Our Outreach Fund continues to attract donors, mostly those who seek to support education for young people aged 5 through 18 including our Eco-Adventure Camp.

Queen's University Biological Station Scholarships 2015

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 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: Heather McKay.

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: Erich Nelson (**Supervisor:** Tufts/Wang) and Tiara Jacobsen (**Supervisor:** Yakimowski/Eckert).

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 one-summer 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 long-term studies.

Awarded to: Prianka St. John (**Supervisor:** Bonier), Victoria Guba (**Supervisor:** Nelson/Arnott), and Emily Drinkwater (**Supervisor:** Arnott/Sinclair).

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: William Twardek. **Supervisor:** Stephen Lougheed & Steve Cooke

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: Erin Kelly (**Supervisor:** Nelson/Arnott) and Carmen Gemmell (**Supervisor:** Stephen Lougheed).

Opinicon Outreach

The major locus of QUBS outreach is our Elbow Lake Environmental Education Centre and we report on its activities later in this report. However, we continue to host some important outreach events at our Opinicon campus as well.

Opinicon Seminar Series

As always we had an engaging spring and summer seminar series with talks every Wednesday at 7:00 pm given by graduate students, postdoctoral fellows, professors, and experts.

Date	Speaker	Talk Title
6 May	Stephen Lougheed <i>Queen's University</i>	Southern South American Biodiversity: Biogeographic Perspectives on Species Origins.
13 May	William Halliday <i>University of Ottawa</i>	What ecological factor is most important to habitat selection by northern snakes?
20 May	Steve Lukits <i>Royal Military College</i>	Mon pays c'est l'hiver: Winter at Opinicon.
27 May	Austin J. Gallagher <i>University of Miami / Carleton University</i>	Unraveling the mysteries of the largest predator in tropical waters, the tiger shark.
3 June	Chris Elvidge <i>Carleton University</i>	Dealing with fear: the cognitive ecology of predator-prey interactions.
10 June	Amanda Tracey <i>Queen's University</i>	Reflecting on seven field seasons at the Queen's University Biological Station.
17 June	Haley Kenyon <i>Queen's University</i>	Genes vs. culture: Bird song across a hybrid zone.
24 June	Laura Schoenle <i>Virginia Tech</i>	Avian malaria in red-winged blackbirds: Putting stress to the test.
1 July	Paul Finigan <i>Queen's University</i>	Littoral fish community changes in Southeastern Ontario.
8 July	David Clark <i>The Catholic University of America</i>	Bones of contention - zooarchaeology and interpreting past human foodways.
15 July	Adam Meyer <i>Queen's University</i>	The fitness consequences of daily vertical migration: What controlling behaviour with robots can tell us about the maintenance of behavioural diversity in <i>Daphnia</i> .
22 July	Bruce Gray <i>Operations Officer for Diving at Environment Canada</i>	How to blow bubbles and make a career out of it - Scientific diving and research in Canada.
29 July	James Sinclair <i>Queen's University</i>	Strength in size or numbers – disentangling the factors involved in the establishment of non-native species.
5 August	Julia Colm <i>Queen's University</i>	Ecology of imperiled grass pickerel: Predicting distributions and examining factors in their decline.
12 August	Jim Austin <i>University of Florida</i>	Life is a beach: Conservation research on an endangered beach mouse.
19 August	Marvin Gunderman <i>McMaster University</i>	Spineless creatures: Their fantastic and curious world.
26 August	Stephen Lougheed <i>Queen's University</i>	My favourite species and why.

QUBS Open House and Library Opening

On Sunday June 28th 2015, we celebrated the 70th anniversary of QUBS at our annual open house. By our reckoning this was the 43rd QUBS open house. Despite an incessant drizzle we estimate between 300 and 400 visitors with myriad displays showcasing the research and teaching at QUBS. We also had the Grand Opening of the Jessie V. Deslauriers Centre for Biology with its new Jack Hambleton Library and new digs for the Fowler Herbarium. The open house was attended by many dignitaries including Sophie Kiwala (MPP Kingston & The Islands), Daniel Woolf (Queen's University Principal), Tom Harris (Queen's Vice Principal, Advancement), Susan Mumm (Dean, Faculty of Arts & Science), Gordon Smith (Vice Dean, Faculty of Arts & Science), and Martha Whitehead (Vice Provost & University Librarian).



Queen's Ph.D. student discusses snapping turtle ecology with some of the Open House attendees. Photo by Greg Black.



Group photo beside the dedication plaque for the Jessie V. Deslauriers Centre for Biology. From left: Sophie Kiwala (MPP Kingston & The Islands), Daniel Woolf (Queen's University Principal), Tom Harris (Queen's Vice Principal, Advancement), John Witjes (Associate VP Facilities), Susan Mumm (Dean, Faculty of Arts & Science), Lisa Sykes (Senior Development Officer, Arts & Science), Floyd Connor (pass Assistant Manager of QUBS), Gordon Smith (Vice Dean, Arts & Science), Jan Watton (friend of Jessie's), Pat Weatherhead (member of the QUBS Advisory Committee and past PI user for QUBS), Martha Whitehead (Vice Provost & University Librarian), Jo-Anne Mancini (Executive Director of Development, Arts & Science), Raleigh Robertson (past QUBS Director), Lois Robertson (long-time friend and supporter of QUBS), Frank Phelan (QUBS Manager), Adele Crowder (Professor Emerita, Queen's University & past Fowler Herbarium Curator), Steve Lougheed (QUBS Director), Carolyn Bonta (Manager, Elbow Lake Environmental Education Centre). Photo by Greg Black.

QUBS Community Dinner

Our 8th annual community dinner occurred on Wednesday 2nd September. The meal was prepared by our Head Cook Veronika Jaspers-Fayer with help from family, friends and QUBS staff. Attendees listened to Ottawa naturalist Rob Alvo speak on the value of research, on his personal experiences at QUBS and elsewhere, and on his soon-to-be published book "Being a bird in North America."

Fabulous Fall Fungi

In 2015, three sessions of *Fabulous Fall Fungi* were offered. This intensive workshop consists of mini-lectures interspersed with field trips to collect specimens. Participants then round up in the classroom to identify their finds, partaking in informal discussions about fungal ecology, natural history and uses. Edible species are prepared for participants to sample. Evening presentations – including opportunity to see bioluminescent mushrooms glow in the dark! – often wrap up a busy day. With *Fabulous Fall Fungi*'s emphasis on developing identification skills, participants are provided printed materials and a local species checklist, and have use of field guides and 10x loupes, an extensive collection of reference books, and high-quality compound microscopes to enable close-up views of fungal spores.

Fabulous Fall Fungi - 2015



FABULOUS FALL FUNGI WORKSHOPS

Instructor: Richard Aaron

Queen's University Biological Station

Workshop 1 - September 29 to October 2; Workshop 2 - October 6 to 9

Third Workshop Added! Sept 8-11

- now in its 6th year – suitable for all levels from beginner to advanced
- wide variety of hands-on activities
- see up to 150 species
- experience a glow-in-the-dark mushroom
- learn about edible and medicinal species
- small class size - limited to 12 participants per workshop
- \$375 fee covers: 3 nights accommodation, 8 meals, 3 field trips & all instruction

For further details and to register, go to: www.queensu.ca/qubs

Other Opinicon Outreach Activities

- April 9-12, Boy Scouts from Toronto Region. Led by Peter Murray (25 attendees)
- April 29-May 1, Osprey (Opeongo High School Outdoor Education Class). Led by Tim Demmons (22 attendees).
- July 22, Visit from SHAD Valley high school interns attending Queen's University. Led by Stephen Lougheed (9 attendees)

Infrastructure, Renovations and Maintenance

With the grand opening of the Jessie V. Deslauriers Centre for Biology we have added some wonderful new teaching and learning spaces to QUBS. Architect for the Centre was Todd Storm of Shoalts and Zaback Architects Ltd. The centerpiece is the Jack Hambleton Library, named after donor Jessie Deslauriers' father, a journalist, outdoorsman, and author.



The Jessie V. Deslauriers Centre for Biology. Photo by Greg Black.

The new Centre also includes the Fowler Herbarium, which contains over 140,000 plant, moss, and lichen specimens spanning the Northern Hemisphere with particular emphasis on Eastern Ontario and the Canadian Arctic. David Lougheed has created a new web site: <https://fowlerherbarium.ca/>. Specimens extend back to the mid 19th century and even include some from Catharine Parr Traill, English-Canadian pioneer, author and naturalist (although these specimens reside in special collections on main campus now). On the lower level are three teaching/research labs that provide new well-lit space for classes or visiting researchers. The Centre is climate-controlled using a geothermal system moving QUBS to a more sustainable footprint.



Jack Hambleton Library. Photo by Greg Black

At Opinicon, as always, there were myriad routine and larger maintenance and stewardship projects. Space precludes listing all of these here of course but larger projects included: finishing the Deslauriers Centre for Biology building including all painting and landscaping, construction of new steps from between the Brown Lab and the Deslauriers Centre, moving the herbarium from main campus, replacement of windows in Raleigh J. Robertson Biodiversity Centre, maintenance of all tree swallow boxes and predator guards, retrofitting and maintenance of satellite-linked climate

stations, constructing of new washroom in White House, painting/staining of Sumac Cottage, Cabins #12 and #13, Maplewood Cottage and Aquarium Building, and construction of a new trail bridge on the Bonwill Tract.

At ELEEC, ageing and failing infrastructure poses a significant challenge. Continuing efforts of previous years, the roof of Cabin 5 was replaced. The main-level deck of Day Lodge was re-constructed in the fall, and included a railing in anticipation of this being a stand-alone deck following future removal of all lower-level decks.

Opinicon Teaching

OUPFB and Other Field Courses

QUBS has long been an important venue for field courses, not just for Queen's University students, but also for undergraduates and graduates from other Canadian and international institutions.

Ontario University Program in Field Biology

- Fish & Fisheries. The Science, Conservation and Management (April 26-May 10): Steve Cooke and Connie O'Connor (Carleton University).
- Ecology of Amphibians & Reptiles (May 3 –May 16): Stephen Lougheed (Queen's University) and Gabriel Blouin-Demers (University of Ottawa).
- Field Entomology (August 9 – August 22): Marvin Gunderman (McMaster University).
- Field Ecology & Natural History (August 16 – August 29): Grégory Bulté (Carleton University)



Ecology of Amphibians & Reptiles field course. Students doing morphometric studies of frogs at Curtis Marsh. Photo by S.C. Lougheed.

Summer 2015 saw another successful running of our China-Canada field course, started in 2005 by Yuxiang Wang, and now co-taught by Yuxiang and QUBS Director Steve Lougheed.

- Effects of Human Development on Aquatic Environments and Biodiversity in Canada and China (July 26 – August 8): Stephen Lougheed & Yuxiang Wang (Queen's University).

Right: Visit to Ravensview Wastewater Treatment Plant in Kingston. Photo by S.C. Lougheed.



Thirty-one students came from Trent, Western, York, Toronto, Memorial, and Queen's through OUPFB, while Chinese students came from Southwestern (Chongqing), Tongji and Fudan (Shanghai, and Beijing Normal University. Students learned about diversity of different taxonomic groups and how to survey them, and gained hands-on insight on how to assess wetlands. Myriad issues of human activities and their impacts on aquatic environments were the focus of many discussions. Class excursions included trips to the main Queen's Campus, the Ravensview Wastewater Treatment Plant, and the Thousand Islands.

Other Field Courses

- Occupational Diving (Jul 11 – 26): Nigel Waltho (Carleton University); Geof Hall (Queen's University); Torben Brydges (University of Guelph) (6 students).
- Natural history (May 18 – 23): Jim Ludden (College of Dupage) (12 students)

Field Trips for Lecture-based Courses

- BIOL202 (*Diversity of Life II*). Led by instructor Barb Vanderbeld (22 students).
- September 12-13, Queen's University Environmental Education, Diane Lawrence (ca. 30 students).
- September 26-27, BIOL302 (*Population & Evolutionary Ecology*). Ecology Weekend # 1. Led by Instructor Laura Nagel. (approximately 90 students).

- September 26, BIOL 201 (*Diversity of Life I*). Led by instructor Barb Vanderbeld (approximately 25 students)
- October 3-4, BIOL302 (*Population & Evolutionary Ecology*). Ecology Weekend # 1. Led by Instructor Laura Nagel. (ca. 90 students).
- October 3-4, BIOL335 (*Limnology & Aquatic Ecology*). Brian Cummings (Queen's University) (13 students)
- October 17-18, Graduate Student Boot Camp. Led by Fran Bonier & Wayne Snedden (31 students).
- November 13-15, Carleton University Environmental Science course. Richard Amos (ca. 40 students)

Opinicon Conferences, Meetings and Retreats

- March 20-21, Science Quest staff retreat led by Outreach Coordinator Ryan Cattrysse. (12 participants)
- April 25, Ontario Woodlot Association meeting (approximately 50 attendees)
- May 1-3, 31st Annual Great Lakes Mycology Meeting (41 attendees).
- June 10, Queen's University Surveillance Studies Conference (20 attendees).
- Queen's-Tongji Sino-Canada Workshop for Aquatic Environmental Sustainability and Development. July 16-18 (approximately 30 attendees)
- July 22, Retirees Association of Queen's University (19 attendees).
- August 12-14, Collaboration meeting for the PICO project - a dark matter search experiment presently in the [SNOLAB](#) underground laboratory at Sudbury, Ontario, Canada (37 attendees).
- September 18-20, Entomological Society of Ontario Annual General Meeting and Conference (approximately 45 attendees).

Opinicon Research Summaries

❖ **Lonnie Aarssen** (*Biology, Queen's University*)

Research projects:

1. Plant Ecology and Evolution (with Paul Grogan)
2. Permanent deer exclosures (with Paul Grogan)
3. Long-term resource addition experiment

Funding: NSERC Discovery

Students and field assistants:

1. Emily Morris
2. Avery Devito
3. Amanda Tracey (Ph.D. candidate)

Undergraduate theses (involving work done at QUBS):

Jennifer Macmillan (2014). Recruitment success for mast-year cohorts of sugar maple over three decades of heavy deer browsing. BSc(Hons) Thesis, Queen's University.

Graduate theses:

1. Amanda Tracey – “Relationships between species body size, reproductive success and abundance in herbaceous vegetation: revisiting the size-advantage hypothesis for competitive fitness” – PhD Thesis
2. John Serafini – “Effects of resource manipulation on neighbourhood composition and productivity in old-field vegetation” – MSc Thesis
3. Emily Morris – “Minimum reproductive threshold size variation in plants: exploring environmental and genetic effects” – BSc(Hons) Thesis

Publications:

1. Scott SL, Aarssen LW (2013) Leaf size versus leaf number trade-offs in dioecious angiosperms. *Journal of Plant Ecology* 6: 29-35.
2. Dante SK, Schamp BS, Aarssen LW (2013) Evidence of deterministic assembly according to flowering time in an old-field plant community. *Functional Ecology* 27: 555–564.

3. Schamp BS, Aarssen LW, Wight S (2013) Effects of 'target' plant species body size on neighbourhood species richness and composition in old-field vegetation. *PLoS ONE* 8(12): e82036. doi:10.1371/journal.pone.0082036
4. Schamp BS, Aarssen LW, Wight S (2013) Effects of 'target' plant species body size on neighbourhood species richness and composition in old-field vegetation. *PLoS ONE* 8(12): e82036. doi:10.1371/journal.pone.0082036
5. Nishizawa T, Aarssen L (2014) The relationship between individual seed quality and maternal plant body size in crowded herbaceous vegetation. *Journal of Plant Ecology* 7: 330–336.
6. Aarssen LW, Schamp BS, Wight S (2014) Big plants — Do they affect neighbourhood species richness and composition in herbaceous vegetation? *Acta Oecologica* 55: 36-42.
7. Tracey AJ, Aarssen LW (2014) Revising traditional theory on the link between plant body size and fitness under competition: evidence from old-field vegetation. *Ecology and Evolution* 4: 959–967.

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

Research projects:

1. Lakes as sentinels of environmental change: Quantifying land-water linkages to predict future change.
2. Teasing apart the relative importance of propagule size, number, diversity, and condition.

Funding:

1. Science Horizons, Environment Canada (Project 1)
2. NSERC Discovery grant, NSERC Strategic Network – CAISN (Project 2)

Students and field assistants:

1. Shawn Rivoire (Environment Canada intern)
2. James Sinclair (PhD student)
3. Emily Drinkwater (undergrad summer assistant)
4. Jeannie Pau (field assistant, undergraduate thesis student)

Undergraduate theses:

Philip Anderson (BSc 2015). Relationships between physical-chemical characteristics, zooplankton and fish communities in freshwater lakes of the Frontenac Arch. Co-advised with Bruce Tufts (Queen's University).

Graduate theses:

James Sinclair (PhD in progress) Teasing apart the relative importance of propagule size, number, diversity, and condition.

❖ **Gabriel Blouin-Demers** (*Biology, University of Ottawa*)

Research Projects:

1. Habitat selection in eastern garter snakes (2013).
2. By-catch of freshwater turtles in commercial fishing (2011-12).
3. Disturbance of freshwater turtles by boats (2014).

Publications:

1. Midwood JD, Cairns NA, Stoot LJ, Cooke SJ & Blouin-Demers G. 2015. Bycatch mortality can cause extirpation in four freshwater turtle species. *Aquatic Conservation: Marine and Freshwater Ecosystems* 25: 71-80.
2. Maillet Z, Halliday WD & Blouin-Demers G. 2015. Exploratory and defensive behaviours change with sex and body size in eastern garter snakes (*Thamnophis sirtalis*). *Journal of Ethology* 33: 47-54.
3. Châteauvert JL, Bulté G, Poulain AJ, Campbell LM & Blouin-Demers G. 2015. Dietary reliance on benthic primary production as a predictor of mercury accumulation in freshwater fish and turtles. *Water, Air, & Soil Pollution* 226: 337.
4. Jain-Schlaepfer SMR, Blouin-Demers G, Cooke SJ & Bulté G. 2016. Do boating and basking mix? The effect of basking disturbances by motorboats on the body temperature and on the energy budget of the northern map turtle. Accepted pending revision.
5. Halliday WD & Blouin-Demers G. 2016. Differential fitness in field and forest habitat explains density-independent habitat selection by gartersnakes. Accepted pending revision.

❖ **Fran Bonier** (*Biology, Queen's University, affiliate faculty Virginia Tech Department of Biological Sciences*)

Research Projects:

1. Long-term monitoring of the QUBS Tree Swallow population
2. Effects of nest ectoparasites on parental behavior and fitness in Tree Swallows
3. Effects of glucocorticoid hormones on tolerance and resistance of malarial parasite infection in Red-Winged Blackbirds
4. Behavioral endocrinology in Black-capped Chickadee

Funding:

1. US National Science Foundation Grant (projects 1-3)
2. US Environmental Protection Agency Science to Achieve Results Scholarship (project 3)
3. National Science and Engineering Research Council of Canada Discovery Grant (project 4)
4. Queen's University Biology Department Research Initiation Grant (project 4)
5. Queen's University Summer Work Experience Program (projects 1-3)

Students and Field Assistants:

1. Matthew Richardson, Queen's University Biology undergraduate, SWEP supported (project 1 and 2)
2. Marcus Threndyle, Queen's University Biology undergraduate, SWEP supported (project 1 and 2)
3. Prianka St. John, Queen's University Biology undergraduate, SWEP supported (project 3)
4. Alana Dudek, Virginia Tech Biology undergraduate (project 3)
5. Meredith Kernbach, Virginia Tech Biology undergraduate (project 3)
6. Thomas Griffiths, Queen's University Biology undergraduate (project 3)
7. Laura Schoenle, Virginia Tech Biology PhD student (lead student on project 3)
8. Anthony Colangelo, Queen's University Biology undergraduate (project 2 & 4)
9. Olivia Yau, Queen's University Biology post-graduate (project 4)
10. Kelsey Schoenemann, Queen's University Biology MSc student (co-lead student on project 4)
11. Chloe Montreuil-Spencer, Queen's University Biology MSc student (co-lead student on project 4)

Undergraduate theses (from work done at QUBS):

1. Prianka St. John; Among and within individual variation in nest defense behaviour in Tree Swallows (*Tachycineta bicolor*). Thesis completed in 2015.
2. Matthew Richardson; The effects of nest ectoparasites on parental behavior and fitness in Tree Swallows. Thesis currently underway, data collected at QUBS in 2015.
3. Anthony Colangelo; The effects of nest ectoparasites on Tree Swallow nestling white blood cell profiles. Thesis currently underway, data collected at QUBS in 2015.

Graduate theses:

1. Sara Burns; No evidence of sampling bias in a comparison of two common methods for capturing free-ranging birds. MSc thesis completed in 2015, data collected at QUBS 2013-2015.
2. Laura Schoenle; The effects of glucocorticoids on tolerance and resistance of malarial parasite infection in Red-Winged Blackbirds. PhD thesis currently underway. All field and captive work completed at QUBS 2013-2015.
3. Chloe Montreuil-Spencer; Characterizing the life history phenotype of Black-capped Chickadees using physiological metrics. MSc thesis currently underway, data collection began at QUBS in 2015 (and continues to date, including winter field work in 2015-16).
4. Kelsey Schoenemann; The repeatability of physiological metrics in Black-capped Chickadees. MSc thesis currently underway, data collection began at QUBS in 2015 (and continues to date, including winter field work in 2015-16).

Publications:

1. Dakin R, AZ Lendvai, JQ Ouyang, IT Moore, and F Bonier. 2016. Plumage colour is associated with partner parental care in mutually ornamented tree swallows. *Animal Behaviour* 111: 111-118.
2. Ouyang JQ, AZ Lendvai, R Dakin, AD Domalik*, VJ Fasanello*, BG Vassallo*, MF Haussmann, IT Moore, and F Bonier. 2015. Weathering the storm: parental effort and experimental manipulation of stress hormones predict brood survival. *BMC Evolutionary Biology* 15: 219.

3. Rohwer VG, F Bonier, and PR Martin. 2015. Conflict between biotic and climatic selective pressures acting on an extended phenotype in a subarctic, but not temperate, environment. *Proceedings of the Royal Society B* published online 21 October, doi: 10.1098/rspb.2015.1585
4. Lendvai AZ, C Akcay, JQ Ouyang, R Dakin, AD Domalik*, PS St. John*, M Stanback, IT Moore, and F Bonier. 2015. Analysis of the optimal duration of behavioral observations based on an automated continuous monitoring system in tree swallows (*Tachycineta bicolor*): Is one hour good enough? *PLoS One* doi: 10.1371/journal.pone.0141194.
5. Lendvai AZ, C Akcay, T Weiss, MF Hausmann, IT Moore, and F Bonier. 2015. Low cost audiovisual playback and recording triggered by radio frequency identification using Raspberry Pi. *PeerJ* 3: e877.

* Indicates undergraduate student co-authors.

❖ **Steven J. Cooke** (*Canada Research Chair in Fish Ecology and Conservation Physiology, Director of the Institute of Environmental Science, Carleton University*).

Research projects:

1. Evaluating the influence of nutrition and stress on parental care behaviours, physiology, and reproductive success in wild smallmouth bass.
2. Evaluating the influence of stress and brood size manipulations on parental care behaviour and reproductive success in wild smallmouth bass.
3. Evaluating how chronic cortisol elevations influence the metabolism of centrarchid fish species and what that means for changes in foraging behaviour and predation risk.
4. Examining the effects of boat noise as an ecological disturbance on the risk-averse behaviours and personality traits of bluegill sunfish.
5. Generating knowledge to support the application of catch-and-release angling techniques on relevant gamefish.
6. Evaluating the potential for long-standing fish sanctuaries to maintain phenotypic diversity.

Funding: NSERC and the Canada Research Chairs Program.

Students and field assistants:

1. Aaron Zolderdo (M.Sc. candidate)
2. Dirk Algera (M.Sc. candidate)
3. Mike Lawrence (Ph.D. candidate)
4. Jill Brookes (Research Assistant)
5. Jake Brownscombe (PhD candidate)
6. Jordann Foster (Undergraduate thesis student)
7. Laura Elmer (International Intern Student)
8. Connor Reid (Summer Work Experience Program intern)
9. Emma Cooke (Undergraduate thesis student)
10. James Logan Monaghan (Summer Work Experience Program intern)
11. William Twardek (Undergraduate thesis student)
12. Sofia Jain-Schlaepfer (Research Assistant)
13. Alizeh Alvi (Undergraduate thesis student)
14. Shannon Clarke (Summer Work Experience Program)
15. Austin Gallagher (Post-doctoral Researcher)
16. Chris Elvidge (Post-doctoral researcher)
17. Alex Wilson (Post-doctoral Researcher)
18. Lee Gutowsky (Post-doctoral Researcher).

Undergraduate theses:

1. Jordann Foster (In progress. To defend 2016) Provisional thesis title:
Consequences of littoral zone light pollution on the parental care behaviour of a freshwater teleost fish.
2. Will Tarddek (In progress. To defend 2016) Thesis title: Fishing for answers: Do protected areas prevent the selective removal of the “best” largemouth bass dads?
Co-supervised with S. Lougheed (Queen’s University)
3. Emma Cooke (In progress. To defend 2016) Provisional thesis title: Does angling pressure and capture method favour different personality types in largemouth bass.
4. Alizeh Alvi (In progress. To defend 2016) Provisional title: Provisional thesis title:
Environmental modulation of the repeatability of the stress response in a teleost fish

Graduate theses:

1. Zolderdo, A (M.Sc thesis defended 2015) Thesis title: Does nutritional status mediate the consequences of elevated cortisol on wild fish? Field manipulations using wild smallmouth bass.
2. Dirk Algera (In progress. To defend 2016) Thesis title: The influence of endogenous and exogenous factors on parental care behaviours and reproductive success in nest guarding male smallmouth bass
3. Mike Lawrence (PhD began 2014) Does chronic stress mediate predator-prey interactions in wild fish? An experimental approach using exogenous cortisol implants.

Other projects:

1. Brownscombe, J. W., and S.J. Cooke. The efficacy of assisted ventilation techniques for facilitating the recovery of fish that are exhausted as a result of recreational angling (In progress for submission).
2. Zolderdo, A.J., A.D.M. Wilson, K.M. Gilmour, and S.J. Cooke. Do protected areas mitigate the impacts of fisheries-induced evolution? A multi-lake field study comparing the physiological stress response between sub-populations of largemouth bass inside and outside of protected areas (In progress for submission).

Publications:

1. Zolderdo, A.J., D.A. Algera, M.J. Lawrence, K.M. Gilmour, M.D. Fast, J. Thuswaldner, W. Willmore and S.J. Cooke. In Press. Stress, nutrition and parental care in a teleost fish: Exploring mechanisms with supplemental feeding and cortisol manipulation. *Journal of Experimental Biology*.
2. Killen, S.S., B. Adriaenssens, S. Marras, G. Claireaux and S.J. Cooke. In Press. Context-dependency of trait repeatability and its relevance for management and conservation of fish populations. *Conservation Physiology*.
3. Sullivan, B.G., A.D.M. Wilson, L.F.G. Gutowsky, P.H. Patrick, M. Sills and S.J. Cooke. In Press. The behavioral responses of a warm-water teleost to different spectra of light emitting diodes. *North American Journal of Fisheries Management*. 00:000-000.

4. Lynch, A. J., S. J. Cooke, A. Deines, S. Bower, D. B. Bunnell, I. G. Cowx, V. M. Nguyen, J. Nonher, K. Phouthavong, B. Riley, M. W. Rogers, W.W. Taylor, W.M. Woelmer, S. Youn and T. D. Beard, Jr. In Press. The social, economic, and ecological importance of inland fishes and fisheries. *Environmental Reviews*.
5. Cooke, S.J., V.M. Nguyen, J.M. Dettmers, R. Arlinghaus, M.C. Quist, D. Tweddle, O.L.F. Weyl, R. Raghavan, M. Portocarrero-Aya, E. Agudelo Cordoba, and I.G. Cowx. In Press. Sustainable inland fisheries – Perspectives from the recreational, commercial and subsistence sectors from around the globe. In G.P. Closs, M. Krkosek and J.D. Olden, Eds. *Conservation of Freshwater Fishes*. Cambridge University Press, Cambridge.
6. Cooke, S.J., Z.S. Hogan, P.A. Butcher, M.J.W. Stokesbury, R. Raghavan, A.J. Gallagher, N. Hammerschlag and A.J. Danylchuk. 2016. Angling for endangered fish: Conservation problem or conservation action? *Fish and Fisheries*. 17: 249-265.
7. Crossin, G.T., O.P. Love, S.J. Cooke and T.D. Williams. 2016. Glucocorticoid manipulations in free-living animals: considerations of dose delivery, life-history context, and reproductive state. *Functional Ecology*. 30:116-125. doi: 10.1111/1365-2435.12482.
8. King, G.D., J.M. Chapman, S.J. Cooke and C.D. Suski. 2016. Stress in the neighborhood: Tissue glucocorticoids relative to stream quality for five species of fish. *Science of the Total Environment*. 547:87-94.
9. King, G.D., J.M. Chapman, J.D. Midwood, S.J. Cooke and C.D. Suski. 2016. Watershed-scale land use activities influence the physiological condition of stream fish. *Physiological and Biochemical Zoology*. 89:10-25.
10. Filguiera, R., J.M. Chapman, C.D. Suski, and S.J. Cooke. 2016. The influence of watershed land use cover on stream fish diversity and size-at-age of a generalist fish. *Ecological Indicators*. 60: 248-257.
11. Veilleux, M.A.N., N.W.R. Lapointe, D.M. Webber, T.R. Binder, P.J. Blanchfield, L. Cruz-Font, M.G. Wells, M.H. Larsen, S.E. Doka and S.J. Cooke. 2016. Pressure sensor calibrations of acoustic telemetry transmitters. *Journal of Animal Biotelemetry*. 4:3. DOI 10.1186/s40317-015-0093-0.
12. Madliger, C.L., S.J. Cooke, E.J. Crespi, J.L. Funk, K.R. Hultine, K.E. Hunt, J.R. Rohr, B.J. Sinclair, C.D. Suski, C.K.R. Willis and O.P. Love. 2016. Success stories and emerging themes in conservation physiology. *Conservation Physiology*. 4:DOI: 10.1093/conphys/cov057.

13. Dufour, K., L.F.G. Gutowsky, D. Algera, A. Zolderdo, J.M.T. Magel, N. Pleizier, M. Dick and S.J. Cooke. 2015. An experimental test of in-season homing mechanisms used by nest-guarding male Largemouth Bass following displacement. *Behavioural Processes*. 120:87-93.
14. Cooke, S.J., R. Arlinghaus, B.M. Johnson, and I.G. Cowx. 2015. Recreational fisheries in inland waters. Pages 449-465 in J. Craig, editor. *Freshwater Fisheries Ecology*. Blackwell Science, UK.
15. Struthers, D.P., A.J. Danylchuk, A.D.M. Wilson and S.J. Cooke. 2015. Action cameras: Bringing aquatic and fisheries research into view. *Fisheries*. DOI: 10.1080/03632415.2015.1082472.
16. O'Connor, C.M., and S.J. Cooke. 2015. Ecological carryover effects complicate conservation. *Ambio*. 44:582-591.
17. Philipp, D.P., J.E. Claussen, J.B. Koppelman, J.A. Stein, S.J. Cooke, C.D. Suski, D.H. Wahl, D.A.H. Sutter, and R. Arlinghaus. 2015. Fisheries-induced evolution in largemouth bass – linking vulnerability to angling, parental care, and fitness. *American Fisheries Society Symposium*. 82:223–234.
18. Horodysky, A.Z., S.J. Cooke and R.W. Brill. 2015. Physiology in the Service of Fisheries Science – Why Thinking Mechanistically Matters. *Reviews in Fish Biology and Fisheries*. 25:425-447.
19. Wilson, A.D.M., M. Wikelski, R.P. Wilson and S.J. Cooke. 2015. Utility of biological sensor tags in animal conservation. *Conservation Biology*. 29:1065–1075.
20. Wilson, A.D.M., J.W. Brownscombe, B. Sullivan, S.M.R. Jain-Schlaepfer and S.J. Cooke. 2015. Does angling technique and lure type selectively target fishes based on their behavioural type? *PLoS ONE*. 10: e0135848.
21. Rous, A.M., A. Forrest, E. Hart McKittrick, G. Letterio, J. Roszell, T. Wright, and S.J. Cooke. 2015. Orientation and position of fish affects recovery time from electrosedation. *Transactions of the American Fisheries Society* 144: 820-828.
22. Moraga, A.D., A.D.M. Wilson and S.J. Cooke. 2015. Does lure colour influence catch per unit effort, fish capture size and hooking injury in angled largemouth bass? *Fisheries Research* 172: 1-6.
23. Midwood, J.D., N.A. Cairns, L.J. Stoot, S.J. Cooke, and G. Blouin-Demers. 2015. Bycatch mortality can cause extirpation of four freshwater turtle species. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 25: 71-80.

24. Gutowsky, L.F.G., W. Aslam, R. Banisaeed, L.R. Bell, K.L. Bove, J.W. Brownscombe, G.J.J. Burrows, E. Chu, J.M.T. Magel, A.M. Rous, and S.J. Cooke. 2015. Considerations for the design and interpretation of fishing release mortality estimates. *Fisheries Research* 167:64-70.
25. Lennox, R. J., K. Whoriskey, G. T. Crossin, and S. J. Cooke. 2015. Influence of angler hook-set behaviour relative to hook type on capture success and incidences of deep hooking and injury in a teleost fish. *Fisheries Research* 164: 201-205.

❖ **Christopher G. Eckert (Department of Biology, Queen's University)**

Research project: Ecological and genetic causes and consequences of sexual variation in clonal plants

Funding: NSERC Discovery Grant & NSERC Discovery Accelerator Supplement

Students and field assistants:

1. Maggie Bartkowska (Post-Doctoral Fellow)
2. Corrina Thomsen (Undergraduate Thesis Student)

Undergraduate theses:

Thomsen, Corrina (in progress) Vestigilization of sexual traits in asexual populations of a clonal aquatic plant, *Decodon verticillatus* (Lythraceae)

Other work: See Sarah Yakimowski's report on the activities of her student Tiara Jacobsen.

❖ **Mark R. Forbes (Carleton University)**

Research project: Parasite-host interactions between dragonflies and mites.

Funding: NSERC Discovery Grant

Students and field assistants:

1. J.J. Mlynarek (Ph.D. Carleton University)
2. W. Knee (Ph.D. Carleton University)

3. A. Morrill (Carleton University).

Articles:

1. Mlynarek JJ, Iserbyt A, Nagel L, Forbes MR. (in press) Differential water mite parasitism, phenoloxidase activity, and resistance to mites are unrelated across pairs of related damselfly species. PLoS One
2. Nagel L, Mlynarek JJ, Forbes MR. (in press) Comparing natural parasitism and resistance with proxies of host immune response in Lestid damselflies. Ecological Parasitology and Immunology
3. Mlynarek JJ, Knee W, Forbes MR. (in press) Host phenology, geographic range size and regional occurrence explain interspecific variation in damselfly-water mite associations. Ecography

❖ **Paul Grogan (Biology, Queen's University)**

Research project:

Interaction of simulated atmospheric nitrogen deposition and soil texture on plant productivity in Ontario hay grasslands – Stokes field, Opinicon Road

Funding: NSERC Discovery

Students and field assistants:

1. Jordan Constant (Hons thesis 4th year)
2. Sean Delaney (4th year volunteer)
3. Tova Pinsky and Kristen Siegel (2nd year SWEPS)

Undergraduate theses:

Interaction of simulated atmospheric nitrogen deposition and soil texture on plant productivity in Ontario hay grasslands. Completed April 2015

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

Research projects:

1. Using environmental DNA to infer habitat usage of aquatic vertebrates.
2. Climatic variability and calling phenology of eastern Ontario frogs.

Funding: NSERC Discovery Grant and support from the Baillie Family Chair in Conservation Biology

Students and field assistants:

1. Wenxi Feng (M.Sc. candidate)
2. Henry Wang (Summer Work Experience Program intern)
3. Mark Szenteczki (Research Assistant)
4. Mat Kahansky (Undergraduate thesis student)

Undergraduate theses:

1. Cicchino, Amanda (B.Sc. completed 2015) Call evolution of *Pseudacris crucifer*.
2. Twardek, Will (B.Sc. In progress) Thesis title: Fishing for answers: Do protected areas prevent the selective removal of the “best” largemouth bass dads? Co-supervised with S. Cooke (Carleton University)
3. Gemmell, Carmen (B.Sc. In progress) Provisional thesis title: Temporal and spatial habitat partitioning among anuran species of Eastern Ontario.
4. Kahansky, Matthew (B.Sc. In progress) Provisional thesis title: The role of habitat on acoustic adaptations of anuran advertisement calls.

Graduate theses:

Feng, W (M.Sc. In progress) Using eDNA to infer habitat preferences in turtles of conservation concern.

Articles:

Cicchino, A.S., N.A. Cairns & S.C. Lougheed. Reproductive phenology of temperate, female frogs: Missing data in a changing world. Revision submitted to *Herpetological Review*.

Other:

Lougheed, S.C. 2015. DNA insights into species distributions – trilling chorus frogs. Blog post for *Opinicon Natural History*. Published 8 November 2015.

- ❖ Elizabeth A. MacDougall-Shackleton (*Biology, Western University*)
- ❖ Scott A. MacDougall-Shackleton (*Psychology, Western University*)

Research projects:

1. Sexual selection, developmental stress and birdsong.
2. Evolutionary and ecological interactions between wild songbirds and their bloodborne parasites.

Funding: NSERC Discovery Grants

Students and field assistants:

1. Tosha Kelly (Ph.D. candidate)
2. Joel Slade (Ph.D. candidate)
3. Matthew Watson (M.Sc. candidate)
4. Alannah Lymburner (NSERC Undergraduate Summer Research Award student)

Undergraduate theses:

1. Ho, Jennifer (B.Sc. 2015). Syllable sharing is not related to migration distance in male song sparrows *Melospiza melodia*.
2. Lymburner, Alannah (B.Sc. 2015). Testosterone as a potential mediator of migration distance and migratory timing in song sparrows *Melospiza melodia*.

Graduate theses:

MacGillivray, Heather (M.Sc. In progress). Natal philopatry in song sparrows (*Melospiza melodia*) predicts female cellular versus humoral immune function, but does not consistently predict parasitism.

Articles:

1. Potvin DA, PW Crawford, SA MacDougall-Shackleton & EA MacDougall-Shackleton. 2015. Song complexity, not territory location, predicts reproductive success and territory tenure in a migratory songbird. *Canadian Journal of Zoology* 93: 627-633.
2. Schmidt KL, SP Kubli, EA MacDougall-Shackleton & SA MacDougall-Shackleton. 2015. Early-life stress has sex-specific effects on immune function in adult song sparrows. *Physiological and Biochemical Zoology* 88: 183-194.

3. Lymburner A, TR Kelly, KA Hobson, EA MacDougall-Shackleton & SA MacDougall-Shackleton. In revision. Testosterone as a potential mediator of migration distance and migratory timing in song sparrows *Melospiza melodia*. Submitted 2015 to *Hormones and Behavior*, now in revision.

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

Research projects:

1. Species interactions during territory settlement (collaborative project with Dr. Dan Mennill, University of Windsor)
2. Fitness consequences of nest site partitioning in sparrows
3. Preliminary surveys of carrion beetles (*Nicrophorus*)
4. Species interactions and the evolution of song and colour pattern in birds

Funding: Natural Science and Engineering Research Council of Canada (NSERC) Discovery Grant

Students and field assistants:

1. Chris Moser-Purdy, University of Windsor MSc student (project 2)
2. Zach Kahn, University of Windsor MSc student (project 2)
3. Kiera Liblik, Queen's University Biology undergraduate (project 3)
4. Haley Kenyon, Queen's University Biology PhD student (project 4)

Graduate theses:

1. Haley Kenyon; Species coexistence and the evolution of colour pattern and song. PhD thesis (year 2). Preliminary experimental trials at QUBS, 2015.
2. Zach Kahn; Nest site use and ecological partitioning in closely related songbirds. Honours thesis, defended April, 2015.

Publications:

1. Purves, E.F.*, M.A. Conboy, R.J. Robertson, and P.R. Martin. Does white tail patch size signal quality in male Cerulean Warblers (*Setophaga cerulea*)? *Wilson Journal of Ornithology*, in press. [Elisabeth Purves's honours thesis]

2. Rohwer, V.G., F. Bonier and P.R. Martin. 2015. Conflict between biotic and climatic selective pressures acting on an extended phenotype in a subarctic, but not temperate, environment. *Proceedings of the Royal Society B* 282:2015.1585. [Vanya Rohwer's graduate work]

* Indicates undergraduate student co-authors.

❖ **Daniel J. Mennill (Department of Biology, University of Windsor)**

Research projects:

1. Determining if Red-eyed Vireos display neighbour-stranger discrimination
2. Determining if Song Sparrows are more aggressive to neighbours during periods of female fertility

Funding: NSERC Discovery Grant

Students and field assistants: Christopher Moser-Purdy (MSc. Candidate)

Graduate theses:

Moser-Purdy, Christopher (In progress. To defend in 2016). Provisional thesis title: Factors affecting dear enemy effect expression in temperate songbirds.

Articles submitted or published in peer-reviewed journals:

Moser-Purdy, C. & Mennill, D. J. Large vocal repertoires do not constrain the dear enemy effect: a playback experiment and comparative study of songbirds. *Animal Behaviour*. Submitted in January 2016.

❖ **Troy G. Murphy** (*Trinity University, San Antonio, TX, USA*)

Research project: How does fighting experience influence future aggressive outcomes in American Goldfinches (*Spinus tristis*)?

Funding:

1. Trinity University Faculty Development Fund
2. Trinity University Bricker Ecology Fund
3. Trinity University Biology Undergraduate Summer Fellowship
4. Trinity University Hixon Fellowship in Environmental Studies
5. Trinity University Murchison Fellowship
6. NSERC Discovery grant to Robert Montgomerie Queen's University
7. Brown Fund - Queen's University Biological Station.

Students and field assistants:

1. Danielle Freund (Undergraduate Thesis student)
2. Conor Miller (Undergraduate student)
3. Elizabeth Walker (Undergraduate student),
4. Nathan King (Undergraduate student)

Undergraduate theses:

Danielle Freund (2016 in progress) Provisional thesis title: Investment in fighting is effected by both resource holding potential and motivation arising from hunger.

Articles submitted or published in peer-reviewed journals:

Murphy T. G., King N., Miller C., Walker E., Freund D. Aggressive interactions in females: the relationship between body size and previous social experience. (in preparation)

❖ **Bryan Neff** (*Biology, Western University*)

Research Projects:

1. Behavioural ecology and evolution of sunfishes
2. Kin recognition in bluegill sunfish
3. MHC and mating patterns in bluegill
4. Androgens and immunity in bluegill
5. Androgen effects on gene expression

Funding: NSERC Discovery Grant and Discovery Accelerator Supplement

Students and field assistants:

1. Scott Colbourne (Ph.D. candidate)
2. Adriano Cunha (Ph.D, candidate)
3. Mat Stefan (Field assistant)
4. John Loggie (M.Sc. candidate)
5. Lucas Silveira (M.Sc. candidate)
6. Charlyn Partidge (Postdoctoral fellow)

Graduate theses:

1. Adriano Cunha (PhD In progress) Effects of androgens on gene expression in bluegill sunfish.
2. John Loggie (MSc In progress) Androgens and immunity in bluegill sunfish.
3. Lucas Silveira (MSc In progress) The MHC and mate choice in bluegill sunfish.
4. Tim Hain (Ph.D. 2015) The evolution of kin recognition.

Articles:

1. Colborne SF, SR Garner, FJ Longstaffe, and BD Neff. Assortative mating but no evidence of genetic divergence in a species characterized by a trophic polymorphism. *Journal of Evolutionary Biology* In press.
2. Berchtold AE, SF Colborne, FJ Longstaffe, and BD Neff. 2015. Ecomorphological patterns linking morphology and diet across three populations of pumpkinseed sunfish (*Lepomis gibbosus*). *Canadian Journal of Zoology* 93: 289-297.

3. Colborne SF, TJA Hain, FJ Longstaffe, and BD Neff. 2015. The potential for less invasive inference of resource use: covariation in stable isotope composition between females and their eggs in bluegill. *Transactions of the American Fisheries Society* 144: 283-291.
4. Colborne SF, ADM Clapp, FJ Longstaffe, and BD Neff. 2015. Foraging ecology of native pumpkinseed (*Lepomis gibbosus*) following the invasion of zebra mussels (*Dreissena polymorpha*). *Canadian Journal of Fisheries and Aquatic Sciences* 72: 983-990.
5. Partridge C, CMC Rodgers, R Knapp and BD Neff. 2015. Androgen effects on immune gene expression during parental care in bluegill sunfish (*Lepomis macrochirus*). *Canadian Journal of Zoology* 93: 9-13.

❖ **Bill Nelson** (*Biology, Queen's University*)

Research Project:

1. Lakes as sentinels of environmental change: Quantifying land-water linkages to predict future change

Funding: NSERC Discovery Grant

Students and field assistants:

1. Victoria Guba

❖ **Bruce Smith** (*Biology, Ithaca College*)

Research project: DNA barcoding of water mites.

Assistant: Kit Muma

Collaborator: Monica Young, Biodiversity Institute of Ontario, University of Guelph

In 2015, my goal was to collect a wide diversity of water mite taxa for use in DNA bar coding, given that I mainly collected adult *Arrenurus* spp. in prior years. This led me to collect farther afield: some sites were on station property, some were in the general

QUBS region, and some required day trips, with QUBS serving as a home base. Our BOLD (**B**arcode **O**f **L**ife **D**atabase) records now consist of about 950 specimens, 841 good sequences and 793 being bar code compliant. These sequences represent 212 species (based upon morphology and/or strong divergences in sequences), 37 genera, 21 families, and 6 superfamilies. Approximately 43% of the specimens have been collected from the QUBS region, with about 43% of those being collected in 2015. A number of apparent cryptic species are represented in the data base, where morphologically they are almost identical to known species yet the sequences are significantly divergent – some being 10-15% different, where it is generally accepted that deviations of more than 2% indicate separate species. This project is in collaboration with Monica Young, Biodiversity Institute of Ontario, who visited the station for several days this past summer.

❖ **Sarah Yakimowski (Biology, Queen’s University)**

Research project: Evolution of sexual system diversity in *Sagittaria latifolia*, a clonal aquatic plant.

Funding: BUGS (Biology Undergraduate Studies) award to 4th year student Tiara Jacobson.

Students and field assistants: Tiara Jacobson (B.Sc. Honours Student)

Undergraduate theses:

Jacobson, Tiara (in progress) Flowering synchrony of sexual systems in an aquatic plant, *Sagittaria latifolia*

Elbow Lake Environmental Education Centre

Overview

The Elbow Lake Environmental Education Centre had its most successful year to date in 2015, as our range and selection of public outreach offerings grew, volunteerism continued to rise, and the ELEEC enjoyed ever-increasing use by outside organizations.

In spring 2015, the ELEEC was awarded \$5,000 from the Community Foundation for Kingston and Area toward our fall high school and public outreach programs. In September, with additional wage subsidies from KEYS, Joanna Piernicka was hired as a full-time Environmental Outreach Assistant. This contract position ensured sufficient staff to support visits from large high school classes; Joanna also assisted with program development and obtaining permits for our growing collection of wildlife specimens.

ELEEC Outreach Activities

ELEEC Open House

The 4th annual Open House on May 24 celebrated two major accomplishments under our grant-funded Educational Trails Project: The Grand Opening the Red Trail footbridge and the release of the *Elbow Lake Trail Guide* interpretive app. Financial support for the footbridge was provided by the Township of South Frontenac and the County of Frontenac, while the trail app and signage for our educational trails was funded by TD Friends of the Environment Foundation.

Attendance was estimated at 200 visitors on this pleasant, sunny day, and included Mayor Ron Vandewal on behalf of South Frontenac Township, and Advisory Board Member Jeff Clarke on behalf of TD Friends of the Environment Foundation. Also present was app developer David Lougheed and staff from the Queen's University Library, notably Geospatial Data Librarian Francine Berish who greatly assisted with research and licensing for aerial imagery and mapping incorporated into the app.

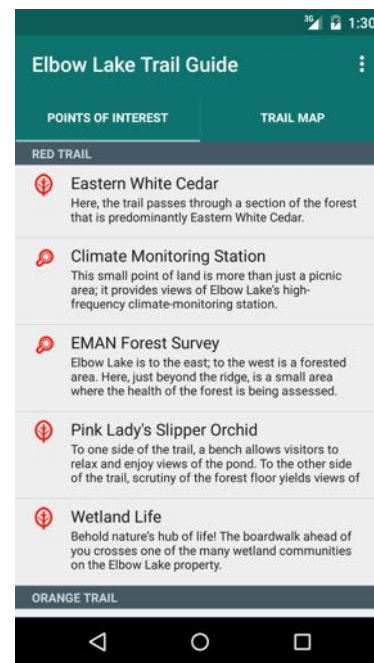
The highlight of the day was an interpretive hike of the Red Trail, co-led by QUBS Director Dr. Steve Lougheed and Manager Carolyn Bonta to explain the development of the interpretive app and point out features highlighted within.

Opening of new bridge at ELEEC. South Frontenac Mayor Ron Vandewal and Carolyn cutting the ribbon for the new footbridge. Photo by Jim Bonta.



Elbow Lake Trail Guide Interpretive App

Efforts to significantly expand self-use educational outreach offerings at QUBS took a major step forward in 2015 with the launch of the *Elbow Lake Trail Guide*. Developed and coded by David Lougheed through 2014, and compatible with both Android and Apple devices, this app introduces visitors to features of natural, cultural or research interest on the Elbow Lake property. Represented as interpretive stations along a trail, each feature is described as a point of interest supported by sound clips, mapping and aerial imagery, links to datasets, and even a fun quiz question to test your knowledge on the subject! The free *Elbow Lake Trail Guide* app can be downloaded from <https://elbowlakecentre.ca/app>.



Eco-Adventure Camp

The 5th summer of Eco-Adventure Camp was led by Director Kristina Silver and Associate Director Gladys Kong, and supported by three regular counselors. Wage subsidies for these five full-time seasonal staff were contributed by the university's Summer Work Experience Program (SWEP), Canada Summer Jobs (CSJ) and Kingston Employment and Youth Services (KEYS).

Camp season kicked off with an overnight Leader-in-Training session attended by ten youth aged 15-18, followed by seven weeks of regular day camp. This year's attendance of 133 participants represented a drop in enrollment from previous recent years, suspected to reflect a substantial increase in camp offerings by other departments at Queen's University. Thanks to the support of private donors, six bursaries were awarded in 2015 to campers in need. Once again, Thursday was "Family Night", and this year ten families stayed overnight at the ELEEC with their young campers.

Secondary School Visits

Participation in ELEEC outreach programs by secondary students far out-numbered attendance numbers from the previous two years. In total, 283 students from 15 classes across four different schools visited the ELEEC in 2015. Teaching assistance was generously provided by six graduate students, one retired educator and one guest presenter from Ducks Unlimited. In addition, staff and graduate students returned to Holy Cross Catholic Secondary School to deliver the in-school Limnology program to 7 classes comprising 198 Grade 9 students.

Our programs continue to emphasize learning objectives from the Grade 9 Science "Sustainable Ecosystems" unit and the Grade 11/12 Biology "Diversity" unit of the Ontario secondary curricula. Programming investigated aspects of biodiversity in areas of limnology, terrestrial invertebrates, ornithology, fisheries and aquatic ecosystems; in 2015, graduate student expertise further exposed students to research in soil microbes and forensic entomology.

Other ELEEC Outreach Activities

Our selection of free public events at ELEEC grew in 2015 to include an *Evening Owl Program*, two live *Dispatches from the Field* presentations (from the popular blog <https://dispatchesfromthefield1.wordpress.com/>), an adult workshop on native *Reptiles at Risk* (hosted by Scales Nature Park), *A Night Under the Shooting Stars* (co-hosted with Firefly Adventures), an Invasive Species Community Seminar and field tour (co-hosted with the Frontenac Stewardship Foundation), and a *Christmas Bird Count for Kids* Citizen Science workshop.

As with previous years, QUBS outreach was represented at Science Rendezvous Kingston, the Skeleton Park Music Festival (Eco-Adventure Camp), and the Verona Cattail Festival – the latter of which included a horse-drawn buggy ride interpreting

natural heritage features along the K&P Trail (co-led with the Frontenac Stewardship Foundation and the County of Frontenac).

Update on Stewardship

Generous funding from the County of Frontenac and a small grant from the National Trails Coalition toward trail infrastructure on the Elbow Lake property enabled the construction of three split-cedar log boardwalks along the Orange Trail. These boardwalks mitigate existing water-crossings, thus improving access to interesting cultural and research features – also representing interpretive stations in the *Elbow Lake Trail Guide* app – along further reaches of this relatively remote trail. We are incredibly grateful to the many volunteers who contributed their time and physical strength to this project.



Volunteers and staff combine efforts to transport materials to remote build sites. Photo by Jérôme McDuff.



A completed boardwalk provides easy access to the 'Predictors of Frog Calling' app station. Photo by Carolyn Bonta.