

***Queen's University Biological Station Annual Report
and Newsletter 2009***



Dr. J. Allen Keast

1922-2009

Director: Dr. Bruce Tufts

Manager: Frank Phelan

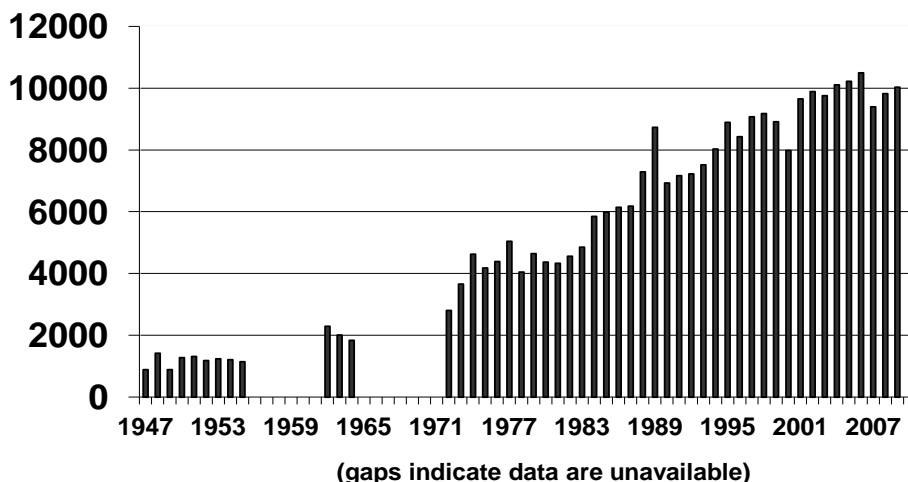
Introduction

The year 2009 was marked by the death of Dr. J. Allen Keast in March. Allen was a one-of-a-kind character and a long-time supporter and enthusiast of the field station. We hired a new Kitchen Coordinator, Veronika Jaspers-Fayer after the retirement of Marg Phelan for medical reasons. Dr. Bruce Tufts started a second three-year term as Director in summer and a new Executive Committee was established. Financial matters once again dominated as we received only a one-year renewal of our NSERC MRS Grant – an ominous sign, indeed.

In 2009, total user-days again exceeded the 10,000 mark, coming in at 10,031 user-days (user-day data are displayed in tabular form on pp 49 - 50). Overall, use was up 2.1% over 2008.

On average, 49 researchers (professors, graduate students, honours students and assistants) were in residence through the summer (May through August). Abstracts of 2009 research projects and documentation of the personnel involved are to be found on pages 16 through 44.

User-Days at QUBS



In teaching activities, QUBS hosted 6 modules (11 weeks worth of modules) in the Ontario Universities Program in Field Biology (OUPFB). Three of these modules were presented by Queen's instructors and one by instructors from other institutions (two courses were collaborative efforts between Queen's and Ottawa U. in one case and Queen's and the St. Lawrence River Institute).

Jim Ludden (a QUBS alumnus) brought a May field course to QUBS from College of DuPage (Glen Ellyn, Illinois). In fall, Ted Thomas and his associates from North Park Collegiate-Vocational School in Brantford brought an elite group of high school students to QUBS for several days of field modules.

A summary of conference, meeting and field trip use of QUBS in 2009 appears later in this report (pp. 45-46).

Dr. J. Allen Keast (November 15, 1922 – March 8, 2009)

Dr. Allen Keast passed away on Sunday, March 8, 2009, at about noon, in Kingston General Hospital where he had been admitted about three weeks earlier due to an infection in his heart. He was in his 87th year.

Allen was born November 15, 1922 in Sydney, New South Wales, Australia. He was an avid naturalist from his earliest boyhood -a passion that continued throughout his career. A family myth suggests that as soon as Allen opened his eyes, his old Scottish grandfather pushed his head up to a bird's nest so he could see into it. As a young boy, he fashioned his interest in natural history by finding nests and being fascinated by the details of colour and pattern of birds' eggs, finding it both a challenge and a thrill to find a nest and add to his egg collection. Even at this early age, his love of nature and his curiosity led him to many outdoor adventures on his own; he told with great pride and fondness how his grandmother allowed him, at age 8, to take a billy can and matches into the bush alone to make tea.

Following high school, Allen served in the Australian Army, being stationed for some 20 months in New Guinea, specifically in New Britain. By this time, his exploration of natural history and, in particular, of the world of birds had led him to develop his typing skills so that he could transcribe his nature notes. This in turn got him a typing job with the command in New Guinea, and provided him with the opportunity to explore the natural history and the avifauna in this tropical rainforest habitat that was of such great interest to him. Rumour has it that his fellow soldiers delighted in putting whatever specimens they could lay their hands on (snakes or otherwise) into his bed for him to find.

Upon completion of his military service, Allen attended the University of Sydney from 1946 to 1950 when he was awarded a B.Sc. with first class Honours. He continued his education at Sydney, while also holding a post as Assistant Curator of Birds, Reptiles and Amphibians at the Australian Museum, and earned an M.Sc. degree in 1952. He recounted with great delight and gratitude how, as an ornithologist at the Australian Museum, he had many opportunities to learn from some of the great amateur naturalists and ornithological masters of the time. Many of these colleagues were self-taught in this regard.

In 1953, Allen was awarded the Peter Brooks Saltonstall Scholarship at Harvard University for his PhD studies. At Harvard, Allen was the first graduate student supervised by one of the leading evolutionary biologists of our time, Professor Ernst Mayr. He also worked with the renowned comparative anatomist, Alfred Sherwood Romer. The Museum of Comparative Zoology at Harvard published Allen's PhD thesis, "Bird Speciation on the Australian Continent" in 1961.

After earning his PhD in 1955, Allen became Curator of Birds, Reptiles and Amphibians at the Australian Museum in Sydney, a position he held from 1955 to 1960. He then held a Visiting Researcher position at the Edward Grey Institute at Oxford University, as well as an appointment in 1962 as Visiting Biologist in South African National Parks, Pretoria, South Africa.

Allen had a very strong interest in Australian natural history and he was also keenly interested in functional morphology and the role of evolution in shaping adaptations and hence community structure. He recognized that the fauna of the isolated island-continent of Australia was very different from that of the southern continents of Africa and South America, and this led Allen to produce major works on evolution in the Southern continents.

Allen joined the Biology Department at Queen's University at Kingston in 1962 as Assistant Professor, and quickly moved up through the ranks to Full Professor, a position that he held until his retirement in 1989.

Upon coming to Queen's, and finding himself in Canada, Allen was faced with a different biota in the cold-dominated, highly seasonal north temperate region, and he saw an opportunity to study biogeography and the forces molding community structure on a much smaller scale – that of the fish fauna in the isolated lakes of southern Ontario. He established a field program at the Queen's University Biological Station at Lake Opinicon, and for more than 30 years examined comparative morphology and competition in those fish communities. This work extended to bird communities, and led to his edited volume "Biogeography and Ecology of Forest Bird Communities," published in 1990 and spanning a diversity of communities from around the globe.

Allen's early interest in natural history and in birds led him to continued work on birds, and involvement with the ornithological communities in both Australia and North America throughout his career. Similarly, his interest in biogeography and the evolution of faunas led him to also continue work on large-scale biogeography and on vertebrate community structure. Hence, Allen never had to choose between these somewhat disparate but complimentary avenues of endeavour, and he managed to balance three major research thrusts, dealing with birds, with fish, and with large-scale biogeography.

Throughout his career, Allen was a strong proponent of field studies and field stations for both research and teaching, recognizing the value of exposing both undergraduate and graduate students to study organisms in their natural environment.

During Allen's time at Queen's, he trained many undergraduates and at least 27 graduate students. He published at least 50 primary research papers, 60 book and conference chapters and 7 books on biogeography. His work served to draw the attention of the world's ecologists and evolutionary biologists to the unique biogeography of Australia. In the Canadian lakes, he was a leader in demonstrating that the ecology of fishes changes dramatically as they grow. He recognized and took advantage of the unique opportunity that lakes provide – that of a suite of organisms locked in isolation in a common environment, often competing for common resources. Over the 25 years he studied fish communities in Eastern Ontario's myriad lakes, especially at the Queen's University Biological Station, he produced another 30 scientific papers in this field.

One of Allen's great strengths was to synthesize. During his career, he edited or co-edited numerous volumes on evolution, biogeography and the relationships of biota, including several on birds. One of his more significant works was a 1980 volume on "Migrant Birds in the Neotropics" co-edited with Eugene Morton, that focused attention on issues of conservation for species that inhabit multiple regions throughout their life cycle, and highlighted a deficiency in our knowledge of Neotropical migrant birds on their wintering grounds.

As Professor Emeritus following his retirement, Allen continued his involvement in field studies, and persisted with his passion for writing. He maintained an active interest in the department, and especially in the Queen's University Biological Station, right up until his death. Allen's generosity and passion for field studies and for the biology station led him to endow the J. Allen Keast Lake Opinicon Undergraduate Research Fellowship, in addition to establishing endowments for lectureships at both the University of Sydney and Queen's University.

In many ways, Allen Keast was larger than life - a generous, passionate, and dedicated biologist with a charm and personality that were both unique and memorable. He will be greatly missed by many friends and colleagues.

Allen was predeceased by a younger brother, John. He is survived by his sister, Janet Baker, who with her husband, Sydney, lives near Seattle.

A memorial service will be held on Friday, March 13th, at 1:30 at the Robert J. Reid Funeral Home - The Chapel on the Corner - 309 Johnson Street, Kingston.

Allen Keast wanted his friends, former students and colleagues to enjoy a good party following any memorial service. In keeping with his wishes, there will be a reception at the University Club where the Main Bar and Fireside Lounge have been reserved from 3:00 to 5:30 PM. Drinks plus hot and cold hors d'oeuvres will be provided.

A 'Celebration of the Life of Allen Keast' is planned to be held at the Queen's University Biological Station at a later date.

In lieu of flowers, the family requests memorial donations to Queen's University, to the J. Allen Keast Lake Opinicon Undergraduate Research Fellowship.

(09/03/11: by Raleigh Robertson and Paul Martin)



A day to remember
Dr. James Allen Keast



Saturday, June 13th, 2009



Please join us for "**Keast Fest**" at Queen's University Biological Station (QUBS) to celebrate the life of **James Allen Keast**. This will be a social time for everyone to reminisce about their time spent with Allen.

You can enjoy:

- pontoon boat rides (1:00 & 2:00 pm departures);
- organized trail walks (1:00 & 2:00 pm and following dinner);
- photo displays;
- memory book (please add to the tribute page on Facebook "*Remembering Emeritus Professor of Biology Allen Keast- the end of an era*"; send an email to Sandy at sberg@kos.net; or by mail c/o QUBS);
- a few short talks highlighting some of Allen's many contributions to science by Allen's colleagues;
- Douglas Library – View Allen's Master's thesis at the Keast display running June 8-15 (Library is open Mon – Fri 8:30 am to 7:30 pm; Sat closed; Sun 12:00 to 4:00 pm).
- Special Guests include Keast family members.

Time: For those of you who wish to come early, lunch will be provided at 12:00 pm; otherwise, start will be after 12:30 pm. The day will end following the last nature walk around 7:30 pm or 'whenever' (party moves to Keast Cottage).

Bring: memories, lawn chairs, coolers and beverages of choice.

R.S.V.P. by June 5th, 2009

Denise Cameron (dcameron3@cogeco.ca) or phone 613-382-1099 (evenings)

Information available at: <http://www.queensu.ca/biology/qubs.html>

PLEASE PASS THE WORD SO THAT WE DO NOT MISS ANYONE.

Keast Fest June 13

In recognition of Dr. Allen Keast, a gathering was held June 13 to celebrate his life and to remember the his enthusiasm, wit and support of the field station and all of its users. Over 100 folks attended to mark the passing of Allen.

Dr. Raleigh Robertson named Fellow of the Royal Society of Canada

OTTAWA - RSC: *The Academies of Arts, Humanities and Sciences of Canada* has elected **77 new Fellows, 2 Specially Elected Fellows and 2 Foreign Fellows**. The newly elected Fellows have diverse backgrounds and disciplines. They have been elected to the Academies of the RSC by their peers in recognition of outstanding scholarly, scientific and artistic achievement.

Election to the RSC is the highest Canadian honour a scholar can achieve in the arts, humanities and sciences.

Founded in 1882, the RSC is Canada's senior and most prestigious scholarly organization. The society has three primary functions: to recognize outstanding contributions to Canadian intellectual culture; to promote Canadian culture abroad; and to advise governments and organizations.

ROBERTSON, Raleigh – Department of Biology, Queen's University

Dr. Robertson is one of Canada's leading environmental scientists and a world authority in Ornithology, Conservation Biology and Behavioural Ecology. He has over 190 refereed publications, is an ISI highly cited researcher, and has trained 50 postgraduates. Dr. Robertson is recognized for building the Queen's University Biological Station into one of the largest and most successful field research stations in North America. He was the inaugural holder of the prestigious Baillie Family Chair in Conservation Biology at Queen's, and most recently received awards from the Society of Canadian Ornithologists and the Canadian Council of University Biology Chairs for lifetime contributions to Canadian biology.

Death of Sherwood Wright

Sherwood and his brother Henry were the original owners of the Cape-Sauriol Environmental Studies Area of QUBS.

WRIGHT, Sherwood Palmer

Ever a gentleman. It is with profound sadness and fond memories we announce that Sherwood passed away at his home on October 16, 2009 in his 89th year. Devoted husband of Joan (Walker) for 63 years. Loving father of Diana, Doug (Paula), Ted (Jo), Cynthia (Claude) and Bill. Adored grandfather of Masha, Peter (Nicole), Emma, Daniel, Simon, Lewis, Pascale and Siena; and great-grandfather of Jason and Jack. Will be sadly missed by his brother Henry (Ann) and many nieces and nephews. Predeceased by his sister Pam. At his request there will be no service. The interment will take place at Mount Pleasant at 1 pm Friday, October 23 and a celebration of his life will be held at 2 pm Friday, October 23 at #38 Avoca Ave. If desired, in lieu of flowers, memorial donations may be made to the charity of your choice and would be appreciated by the family.

Executive Committee

In an effort to gain other perspectives in decision-making at the field station, a new committee was established this year (January). The Executive Committee serves to provide input and advice on policy, procedures and practice in all aspects of the operation of the field station. The committee membership is as follows: Director, Dr. Bruce Tufts; Manager, Frank Phelan; Baillie Chair in Conservation Biology, Dr. Paul Martin; Student Rep, Cory Toth; External Rep., Kit Muma (Ithaca College).

It is the intention that the committee will meet, at minimum, twice a year.

Thousand Islands - Frontenac Arch Biosphere Reserve

QUBS continues involvement with the local Biosphere Reserve. QUBS properties contribute to education, research and conservation programs within the Biosphere Reserve. The Biosphere Reserve recognizes the attributes of the Frontenac Arch and promotes wise land use and sustainability within its borders.

MAJOR GIFTS

Baillie Family Chair in Conservation Biology

Dr. Paul Martin continues as Baillie Chair. He and his students focus on a variety of bird species and avenues of investigation which involve behaviour, phylogeny, population status and conservation. A summary of current topics of research is found later in this report.

William C. Brown Research Endowment Fund

The Brown Fund is used to augment research opportunities at QUBS.

The Queen's Land Trust

The Queen's Land Trust continues to grow, thanks to the generous donations of alumni, friends and QUBS supporters. While still far short of the ultimate goal of an endowed fund of \$1,000,000, the current fund does offer assurance that if a parcel of land that is integral to QUBS should be opened for potential development, QUBS would hopefully be in a position to act. In addition, the income from the land trust helps to cover costs of maintaining the extensive land base at QUBS.

The Land Trust provided the funds for the purchase of the MacLean Place in 2009 (details later in this report).

NSERC and Other Support

Major Research Support Grant

Fall of 2008 was the application deadline for submission of our Major Research Support Program of NSERC. We have held such funding for the past 25 years in various iterations of field station support grants. In 2009, we were awarded a one-year renewal at a reduced level, which is a signal that funding is coming to an end.

In 2008, NSERC criteria for MRS grants changed. To be eligible, field stations must be both of national and international importance. In the past, this read as national or international importance. A small change, indeed, but one with serious ramifications for us. With our array of users from outside of Canada, we have no problem with international importance criteria. However, QUBS was deemed as only of regional importance and thus ineligible for MRS funding. It is the nature of field stations to be of regional importance since nearby researchers are the prime users of any given field station. It is very unlikely that a researcher from a distant institution will be a regular user of a field station in a different part of the country unless there exists a special set of circumstances surrounding a specific species or community assemblage that is the focus of a particular research interest.

We mounted an appeal of the NSERC decision, citing the above argument and providing as much detail as possible about the array of researchers and studies and the long-term and collaborative nature of much of the work. To no avail – our appeal was denied and our Letter of Intent to reapply was declined.

So, the end of direct NSERC support for QUBS. We are not the only field station affected. Once the current funding period runs out, there will be precious few field stations who will be eligible for direct NSERC support. For QUBS, this will affect the position of Assistant Manager, which has been funded through various forms of the MRS grant for a long time. It will also mean that there will be no particle support of our Maintenance Assistant nor any contribution to shared resources. The end of an era.

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Endowment Fund

The newly-established Endowment Fund has been growing thanks mainly to the efforts of Director Dr. Bruce Tufts. This fund is intended to provide supplemental funding for activities, programming and equipment as needed at the field station. The fund currently stands at \$50,000 and is starting to generate interest which we can use to support the operation of QUBS. The principal in the fund will remain untouched. From proceeds, we purchased a high-efficiency coin-operated washing machine for general use. This is part of an effort to “green” the station and trim energy use.

Thanks to all who have contributed to this important fund. We have set an initial target of \$500,000 to be held in the endowment.

Warner Lake Ecological Observatory (WLEO)

Not all of the hydrophones were working – the result of muskrat chewing and water leakage, but enough were serviceable to allow tracking of Largemouth Bass, part of a study by Drs. Cooke (Carleton) and Arlinghaus (Berlin) on movements of angled fish. Fifty tagged largemouth were released into the lake and their subsequent movements followed through the summer, fall and winter.

SCHOLARSHIPS AND BURSARIES

There are a number of awards available to QUBS researchers. Among these are :

- Wes and Dorletta Curran Memorial Award
- Karen Huntley Memorial Award
- Alexander and Cora Munn Summer Research Award
- J. Allen Keast Lake Opinicon Undergraduate Research Fellowship Endowment Fund
- Kingston Field Naturalists

Details of these awards and application procedures are available through Queen's Registrar <http://www.queensu.ca/registrar/awards/toolbox/ArtsSciAwards.htm>

In addition to the awards above specifically tailored to QUBS, the following is a partial listing of awards available to biologists at Queen's:

- Allen and Mary Lou West Memorial Award
- Fran and Tom McClung Scholarship in Biology
- Wallace Near Prize in Biology
- Ann Eliza Stafford Prize in Biology
- The Gray Family Student Initiatives Fund
- Pearl E. Williams and Llewellyn Hillis Fund
- NSERC Summer Undergraduate Research Awards

QUBS Outreach Programs

Seminars

Seminars are a big part of our outreach programs at QUBS. The weekly Wednesday night seminars were popular with regulars and neighbours alike. The seminar program was well-attended with standing room only crowds for many of the offerings. A summary of seminars for 2009 is found in pp. 49-50.

Open House

The 38th annual Open House was held on July 5. Approximately 300 visitors attended. QUBS regulars offered tours of the station and displays of current research projects.

The 2009 version of the Community Newsletter (26th edition) was distributed to some 1,350 households and cottages in the Chaffey's Lock, Elgin, Perth Road, Massassauga Road and Hutchings Road area. This annual circular serves much the same purpose as the Open House, providing information to those interested but unable to attend the Open House itself.

Outreach activities have become a part of the mandate of QUBS, providing educational and research opportunities and information to a wide audience. Outreach activities are an important part of the continuing success of the field station. By way of outreach activities, interested neighbours become stakeholders in the field station itself. The contacts developed are instrumental in maintaining close relations with the local public and in enlisting broad-based support of the field station and its activities. Without the continuing support of the local community, opportunities at QUBS would become somewhat restricted.

QUBS Logistical Support

GIS/GPS and SWEP

This year at the Queen's University Biological Station a Queen's student, Fiona Munro was hired for the four months of the summer to fill the position of Geographic Information Systems (GIS) and Global Positioning Systems (GPS) technician. She was hired through the Summer Work Experience Program (SWEP). Through the experience of field work and computer work this job position allows for the student to increase and develop their skills.

One of the general tasks that were ongoing throughout the summer was to make sure the antivirus software was up to date on all of the computers. This also included making sure other programs were kept up to date. The computers were also checked to make sure there were no unnecessary programs on the computers which were not important to the work at the field station. The program ArcGIS 9.2 was updated to ArcGIS 9.3 on all of the relevant computers, a total of four computers.

The student worked on many GIS projects during the summer at the station to help with other students projects. One of these projects was the mapping of temporary woodland ponds once a month during the duration of the summer to look at how quickly the ponds evaporated. There were a total of nine ponds which required the student to go out into the field to collect the GPS data and then make maps illustrating the ponds changes using the ArcGIS program. Calculations were also made of each pond at each stage to see what the changes in circumference and surface area of the ponds were, using the ArcGIS program. Another project that took place was mapping of the locations of the Columbine plant study areas and any important features such as trees within those study areas. The student used the collected GPS data that was given to them and created maps of the areas with the desired features. Another GIS project that took place was that of the mapping of the Redstart nest locations which the student went into the field to GPS and then created maps and spreadsheets of the locations.

There already exists various help files on how to use the ArcGIS program which are easily accessible on the computers at the station. The student went through and updated these files trying to make them more user friendly and better organized.

The student also helped with some of the community outreach projects that took place during the summer. This included the creation of the community newsletter for 2009, helping with information posters for the open house which took place in July and helping man the information booths at the Corn Roast in Chaffey's Locks in August. At the 38th open house the student had an information poster about GIS and the various GIS projects that were taking place at the station currently.

Acknowledgements

QUBS has become a very busy field station with a multifaceted role to play in research, education, conservation and outreach. A lot of the success of the station is due to the dedication of our staff in core roles, especially general maintenance and foodservice. Thanks to Roger (Rod) Green, our Maintenance Assistant, our

Food Service Staff – Veronika Jaspers-Fayer (Head Cook/Kitchen Coordinator), Angela Baldwin, Helen Crowe and Klara Jaspers-Fayer and our Cleaning Staff, Michelle Phelan.

QUBS Properties

MacLean Place /Property

The Queen's Land Trust was used for the purchase of a small (3.5 acre) property on the Opinicon Road at the entrance to Warner Lake. The property contains a house (badly in need of repair) and a large workshop. The property had gone into receivership and was subsequently offered for sale by the CIBC bank. The purchase was finalized on December 22, 2009. The property was purchased to consolidate QUBS landholdings, to secure access to Warner Lake, to ensure uninterrupted provision of electricity to the Warner Lake Ecological Observatory and as a defensive move to prevent ownership by incompatible residents. Upon renovation, the house and grounds may be rented to QUBS staff, ensuring a watchful presence within the properties along the Opinicon Road. With this purchase, QUBS landholdings now total some 2,762 hectares (6,822 acres).

The name MacLean Place was chosen as a remembrance for the original homesteaders of the parcel, Jim and Harriett (Hattie) MacLean. The present house sits atop the site of the original log cabin.

Agreement Properties

This category includes property which is not owned outright by QUBS/Queen's. As a result of developing partnerships with other Non-Government Organizations with similar aims in conservation and stewardship, acquisitions of significant lands may be done by collaboration and sharing of effort. During 2009, ongoing discussions with the Nature Conservancy of Canada are/have been focussed on **Elbow Lake** – a property just to the southeast of current QUBS holdings. Nature Conservancy Canada has purchased the property and we are working with them to lease the buildings for use as an interpretive and outreach centre and perhaps to become a full partner in the entire property. Discussions are under way to delineate a lease-to-own arrangement that will permit QUBS-sponsored outreach programming in the near future.

Hughson Farm

In 2009, the Hughson Farm was used for studies of Tree Swallows (endocrine studies, populations and survival/recruitment), American Redstarts, American Goldfinch, Yellow Warblers, *Dendroica* warblers, American Robins, long-distance communication in the Common Loon, frog phenology, pond amphibians, damselflies and dragonflies and their parasites, moths, butterflies, water mites, Largemouth Bass, Pumpkinseed Sunfish, plant communities and flowering phenology, plant growth and reproduction, herkogamy in Red Columbine, food webs in ponds and nitrogen and carbon cycling.

The various bird box grids were used by Dr. Fran Bonier, taking over from Dr. Raleigh Robertson upon his retirement, and her students for work on Tree Swallows.

Rotation plots in the Lane Sargent field were used by Dr. Aarssen's lab for a variety of projects. The fenced plot in the New Barn Field is maintained for plant competition studies.

Haying of the open fields was done by and Ken Young in 2009.

Bonwill Tract

The Bonwill Tract was used for studies of American Redstarts, *Dendroica* warblers, frog phenology, pond amphibians, damselflies and dragonflies and their parasites, moths, butterflies, water mites, Largemouth Bass, plant communities and flowering phenology, plant growth and reproduction, food webs in ponds and carbon/nitrogen cycles in 2009.

The Ontario Ministry of Natural Resources (Eric Boysen - Kemptville) maintains several growth and yield plots flanking the Bedford Road. Canadian Wildlife Service Forest Bird Inventory plots are located within the Bonwill Tract, lying north and east of the Wire Fence Field.

John M. Cape - Charles Sauriol Environmental Studies Area

The Cape-Sauriol Tract was used for studies of *Dendroica* warblers, long-distance communication in the Common Loon, Map Turtles, amphibians in ponds, food webs in ponds, Largemouth Bass, Smallmouth Bass, Bluegill, Pumpkinseed, water mites and Purple Loosestrife in 2009.

Hilda and John B. Pangman Conservation Reserve

In 2009, the Pangman Reserve was used in studies of American Redstarts, *Dendroica* warblers, deer browse (exclusion plots), frog phenology, amphibians in ponds, Largemouth Bass, Northern Pike, Bluegill, dragonflies and damselflies and their parasites, water mites, zooplankton community ecology of lakes, food webs in ponds, herkogamy in Red Columbine, plant communities and flowering phenology and plant growth and competition.

In Warner Lake, the Lotek Ecological Observatory was used to monitor the movements of the angled Largemouth Bass. Transmitters implanted in bass enable 3D locations along with pressure (depth) and temperature data.

In Lindsay and Poole Lakes, Northern Pike were implanted with PIT (Passive Integrated Transponder) tags as part of a long-term study on growth, behaviour and movements of pike.

West of the Lindsay Lake Road, five deer exclosures were installed to study of the impact of deer browsing on local vegetation. This will be a long-term study.

The Lindsay Lake Road continues to be a popular place for nature hikes and local history walks by various groups.

Bracken Tract

The Bracken Tract was an important site for studies of Golden-winged Warblers, *Dendroica* warblers, Yellow Warblers, Song Sparrows, American Goldfinch, frog phenology, plant competition (seed quality, size of plants), carbon and nitrogen cycling and resource addition experiment in plants in 2009. This latter project required the establishment of a long-term plot near the old mine site, fenced to keep herbivores out.

In fall, the property was intensively used by students from Geology 221 (Geological Field Methods). Doug Archibald and his students lay out baselines and pickets. With regular sampling, the students determine the stratigraphy of surficial sediments (lacustrine clay and/or sand over till for the most part) using soil augers. In addition, a magnetometer survey determined the location of the buried contact line between the gneiss and the very magnetic gabbro that hosts the magnetite. This work is of interest since the area used to be the site of the Matthews Mine, a very successful iron (magnetite) mine.

Tim Tobin was permitted to graze cattle on this tract in exchange for keeping an eye on the property. Ecologically, the cattle will help to keep some of the property in early successional stages.

Moores Tract

In 2009, the Moores Tract was used in studies of Black-capped Chickadees, Yellow Warblers, American Goldfinch, frog phenology and water mites.

Crabbe Property

The Crabbe House has again been a base of operations for study of Song Sparrows in 2009.

A neighbour, Jim Hales, has been engaged to cut the grass on a regular basis.

Massassauga Tract

The Massassauga property was used in studies of Yellow Warblers, *Dendroica* warblers, frog phenology, moths and butterflies and carbon and nitrogen cycling in 2009.

Ken Young uses the barn for cattle and hay. The open fields were hayed by Ken in 2009.

Camp Outlook made use of the property for hiking and camping in fall and winter.

Boston Wildlands

The Boston Tract was used in studies of *Dendroica* warblers in 2009.

The Boston family will continue to monitor the property and, by agreement, have limited use of the property for maple syrup, wood cutting and recreation.

Queen's Point

In 2009, the islands and mainland property of Queen's Point were used for studies of Black-capped Chickadees, American Goldfinch (aviaries), Yellow Warblers, American Robins, long-distance communication in the Common Loon, frog phenology, Map Turtles, bats, Largemouth Bass, Smallmouth Bass, Bluegill Sunfish, Pumpkinseed Sunfish, Northern Pike, various fish species and stress, various fish species and muscle physiology, moths, fireflies and water mites

Some necessary repairs were made to the boardwalk to Cow Island.

Animal Care, Safety and Training

Animal Care

In November of 2001, a specific policy on animal care was put into place for QUBS. The policy meshes animal care at the field station with University Animal Care Committee (UACC) protocols and approvals. All QUBS users must adhere to the QUBS policy guidelines (<http://biology.queensu.ca/~qubs/AnimalCare.pdf>).

As ethical field researchers and educators, animal care issues are of paramount importance and the welfare of any animal which is the subject of either field or lab study must be foremost in planning and procedures.

Summary of requirements and procedures (get the full policy at website above):

- All activities involving vertebrates must obtain UACC approval
- Activities include: collecting, capturing, tagging, marking, handling, biosampling and housing
- Housing is short-term (less than thirty days)
- Non-Queen's researchers must provide a copy of approved protocol(s) from the home institution along with Animal Use Data Form (AUDF) to Queen's UACC for review.
- Copies of all protocols will be kept with UACC and at QUBS
- Copies of permits should be filed with UACC and QUBS

Dr. Andrew Winterborn is Queen's University Veterinarian and Director of University Animal Care. He is available for discussion of animal care issues at andrew.winterborn@queensu.ca. UACC communications can also be accessed/delivered at UACC@queensu.ca or via Natalie Kolomeitz Douglas, Secretary UACC.

Off-Campus Activity Safety Policy

As of September 2004, Queen's University has adopted a new Off-Campus Safety Policy (OCASP) which supersedes the previous Field Safety Policy. Under the new policy, QUBS is considered to be off-campus, so all of the provisions of the new policy apply to activities at QUBS. The policy document and supporting material can be accessed at <http://www.safety.queensu.ca/policy/activity>.

All Queen's Principal Investigators are required to complete safety planning records in advance of arrival at QUBS, which include risk assessment and risk management. Further, PIs must conduct information sessions with their field and/or lab workers and establish principles and procedures for safety in the field and/or lab. Non-Queen's PIs should undertake a similar process using the materials provided by OCASP as a guideline.

Workplace Hazardous Materials Information System

Queen's University has made it mandatory for all employees to have current training and certification under WHMIS. Under new regulations, all lab workers must have training and must renew this training each year. Even office workers and others not directly working in labs must have exposure to WHMIS training. If a lab uses any chemicals at all at QUBS, it is imperative that all lab workers have WHMIS training. Please arrange for this well before arriving at QUBS.

QUBS is not an appropriate place for extensive chemical usage. Each PI must supply a list of chemicals brought to QUBS when application is made for space. All chemicals brought to QUBS must be accompanied by current MSDS (Material Safety Data Sheets). These sheets must not be more than 3 years old. Place MSDS sheets in the binders at the entrance to your lab.

Bring only small amounts of chemicals to QUBS. Discuss appropriate safe storage, handling and proper disposal with QUBS safety officer, Manager Frank Phelan.

Watercraft Safety

In compliance with current legislation, all users of QUBS motorboats must have proof of operator competency. There are a variety of means of obtaining proof of competency, via local courses or web-based training/testing. A good place to start looking for information is the Canadian Coast Guard (<http://www.ccg-gcc.ca>).

Particular care must be taken when operating QUBS boats, both for safety reasons and because of visibility. Our boats and personnel are easily identified. Therefore, operation of these vessels must be beyond reproach.

Regulations are currently changing. Under new legislation, all QUBS vessels will be considered as commercial vessels. Transport Canada will soon recognize only two classes of vessel - either pleasure craft or commercial craft. Inspection and certification of all QUBS boats will need to be done by Transport Canada. Our two new pontoon boats (DMH II and DMH III) have arrived and are ready for use. These vessels must be piloted by a captain with MED A3 training and are limited to 11 persons (10 passengers and the captain). A session for MED A3 training was held in May, instruction by Navtex (Ray Throop – Kingston Coast Guard Captain). Depending upon interest and need, we can arrange further courses for this training through Captain Ray.

All-Terrain Vehicle Safety

All-terrain vehicles are considered research tools at QUBS. While ATVs are useful tools, especially when equipment must be carried into remote areas, ATVs are also expensive and potentially dangerous. All operators must take a training program before operating ATVs. Proof of training from an established authority is acceptable. For those requiring on-site training, QUBS uses the program developed by 4-H Clubs. Study of safety material and passing a written test, followed by a practical test aboard an ATV is required.

Drinking Water Safety

In the aftermath of Walkerton, stringent regulations were put into place for all water systems in Ontario. QUBS has complied with these as a small, non-municipal drinking water system with a well supply.

To obtain compliance, the following has been done:

- Inspection by a professional engineer (March 2002)
- UV units installed to treat all incoming well water
- Certification of QUBS staff in operation of small drinking water systems (June 2002)
- Weekly water testing for microbiological parameters (Accutest - Kingston)
- Multiparameter test of chemicals, minerals, pesticides and radionuclides (June 2007) - next test in June 2012 – all OK
- Weekly check of water treatment equipment
- Replacement of main septic field as suggested in Engineer's report (fall 2003)
- Annual report filed with Ministry of Environment (May 2004)
- Application to halve the frequency of sampling (May 2005) - we sample water for microbiological parameters every two weeks

We are fortunate that our well provides a good quantity of quality water. Nevertheless, QUBS is in full compliance with current regulations and staff make every effort to ensure the continuing safety of our drinking water.

Fire Safety

QUBS users are probably unaware that monthly fire and general safety inspections are undertaken by QUBS staff at the first of each month. All fire extinguishers, alarms, monitors, first aid kits, eyewash stations etc. are checked in all labs and accommodations. In the process, a check for any and all safety hazards is made across the station. The portable fire pump is also tested and emergency procedures reviewed. When possible, familiarization tours with the local volunteer fire department are conducted so that they can appreciate the requirements of QUBS before arriving during an emergency.

QUBS staff is committed to providing a safe environment at QUBS.

Renovations and Additions

A summary of various projects in 2009:

Ironwood Cottage: Preparatory to reroofing of the cottage, the big overhanging Oak Tree was removed (J and A Tree Service). This tree has long been threatening the building and encouraging moss and deterioration of soffit and fascia. The cottage was reroofed by C/W Roofing (Newboro).

Keast Cottage: Reports of ant chewing in the walls caused us to take a close look at the south wall especially. After tearing off the panelling, extensive damage was discovered. Other problems with framing and wiring caused us to completely strip out the ceilings and intervening walls. This led to a reworking of the two bedrooms, removing the hallway between the rooms, putting in new windows, insulation, wiring, drywall and new entrances to each room. Outside, we dug fill away from the sides of the cottage to prevent rot. Then new siding, soffit and fascia were

installed. The bathroom shower enclosure was removed and rebuilt and a new sink vanity installed to complete the remodelling.

Docks: We replaced the pivots and cross-bracing on all of the docks to make them more stable. A new electrical supply to the docks east of the Boathouse was installed to permit circulation pumps and dockside tank array. Two Little Giant pumps now enable the free-flow tank array.

Signage: Small signs were put up at the gates along the Opinicon Road to discourage ATV and motorcycle trespass.

Operations Centre: A new garbage bin in lodge was created, using the dead space flanking the servery and coffee station. This consisted of a stainless steel front with a hinged door built to our specifications by Dowling Sheet Metal (Kingston).

An overhead fan was installed in the entryway to help deal with wet mats, boots and clothes on rainy days.

A reinforcing plate was constructed for the shelf in front of kitchen servery. Over time, the weight of dishes had forced the shelf to sag and warp.

In the Conference Room, the concrete walls were sealed and coated with special paint to prevent mildew/mold. The men's and women's bathrooms received the same treatment to deal with mildew.

After painting, steel strips were added to the West wall of Conference Room. Using magnets, these strips will be useful for display purposes.

New high-efficiency dryer (Endowment Fund) to match the washer in the laundry room.

A new propane BBQ was purchased for the kitchen to enable "cookout" meals.

Curran Cottage: Remodel shower room. New neo-angle shower, vanity, flooring. Repair side deck.

Maplewood Cottage: Paint bathroom with mildewcide paint. Paint small bedroom.

Boathouse: Build and install new double doors in lower level facing north.

Pangman Tract: With the swale hole becoming worse over time and wet years, we created a new trail around this obstacle on the trail to Long Lake

Bracken Tract: Fencing of Aarssen/Grogan long-term plot near the old mine opening.

Boardwalk: Necessary repairs made

Golf Cart: Replacement batteries (8) purchased and installed

Tractor: Our old tractor got a tuneup by Smith Farm Equip (Jasper)

Dump trailer: Rusted pivots were replaced and a new checkerboard plate floor installed in the bed of the trailer.

Cedar Cottage: Landscaping completed this build. A new interlocking brick front terrace was installed. The addition of topsoil and some retaining walls (log) and some grass seed created lawns surrounding this new cottage.

Aquarium: A new compressor was installed to service the air supply for the aquarium.

Queen's Point: Clearing of brush under Hydro lines

New double/single bunk beds (Ikea) were purchased and installed in Sumac Cottage.

Field Courses 2009

Herpetology	May 3-16	Drs. Lougheed (Queen's) and Blouin-Demers (Ottawa)
Ornithology	May 17-30	Dr. Friesen (Queen's)
Ichthyology	Aug 2-15	Dr. Tufts (Queen's)
Biodiversity and Conservation Ecology - Chinese Exchange Course	Aug 9-15	Drs. Wang and Lougheed (Queen's) plus instructors from Fudan University (China)
Ecotoxicology	Aug 16-29	Drs. Hodson (Queen's) and Ridal (St. Lawrence River Inst)
Field Ecology	Aug 16 – 29	Drs. Blouin-Demers and others (Ottawa)



Research Summaries 2009

Dr. Lonnie W. Aarssen, Department of Biology, Queen's University

“Plant Ecology and Evolution”

Research in this lab focuses on the interpretation of adaptive strategies for growth, survival and reproduction in plants along environmental gradients and how these strategies help to explain patterns in the abundance, distribution and diversity of organisms, taxa, biomass and productivity within and between habitats.

Dr. Lonnie Aarssen and Dr. Paul Grogan (Queen's)

“Long-term resource addition experiment”

A long term (10-year) experiment at the Bracken Tract was initiated in the summer of 2009 in a field near the old mine shaft, involving 240 plots measuring 2 m x 2m each, with treatments to commence in 2010 involving rain-out shelters, exclosures to prevent deer grazing, annual soil nutrient manipulation, and weekly plot watering. Treatments will continue for 10 years, and both vegetation and soil sampling will be conducted periodically. A fence was installed around this field in August, which allowed us to avoid cattle disturbance during our initial survey, plot layout, and quadrat anchor installation etc. This project will be the first large-scale, long-term test of whether, *in non-arid habitats*, water is the most limiting resource affecting plant competition and community structure and assembly in natural vegetation. We predict that on average, over several years (i.e. including across dry and wet years) water is the most important object of competition and limitation on biomass production in the mesic temperate deciduous forest climatic region of eastern Ontario Canada (average annual precipitation - about 850 mm). In other words, compared with nutrient supplementation, we predict that plain water supplementation within vegetation plots will cause most of the increase in biomass production over control plots, and that the nutrient effect will interact with water availability. This study will also permit an examination of how these soil resource effects depend on the effects of deer and rabbit herbivory (using caged versus uncaged plots). The plots will also be used to explore several questions about effects of water and nutrient limitation on plant traits, phenotypic plasticity, competitive interactions, diversity, species composition/ coexistence, and several soil properties.

Assistants: Sarah Dombrowskie, Amanda Tracie, Karen Dante

Acknowledgements: Funded by NSERC discovery grants to Lonnie Aarssen and Paul Grogan.

Amanda Tracie – “Species size and reproductive economy in vegetation” – B.Sc.(Hons)
Thesis.

According to traditional theory based on previous experimental studies, superior competitive ability in plants generally requires relatively large plant size. It seems a paradox therefore, that most species that coexist within natural vegetation are relatively small; i.e. size distributions are virtually everywhere strongly right-skewed. One possible explanation (hypothesis) will be explored here: that smaller plant species can coexist with larger species because smaller species have greater reproductive economy – i.e. ability to reproduce despite suppression from intense competition. A recent study has shown that, under the most intensely crowded conditions within natural herbaceous vegetation, most of the total offspring production within a population that is available to form the next generation routinely comes from the relatively large numbers of suppressed resident plants that belong to relatively small size classes. Another recent study found that smaller species have larger ‘bud banks’ (i.e. larger numbers of axillary meristems per unit plant body size) that can be potentially deployed for reproduction, which may in turn confer greater reproductive economy. These results suggest that smaller resident species within natural vegetation may be expected to have smaller reproductive size thresholds, and may be expected to be reproductive at a smaller fraction of their maximum potential plant sizes. This hypothesis will be tested in the present study at 2 spatial scales (1x1 m plot, and the whole community), at four time periods (early, mid, late, later) in the growing season, and for two patch types (low litter versus high litter).

Assistants: Sarah Dombrowskie, Karen Dante

Acknowledgements: Funded by NSERC discovery grant to LWA.

Karen Dante – “Organization of Plant Communities with respect to Flowering Phenology”
– B.Sc.(Hons) Thesis (co-supervision with Brandon Schamp, Algoma University).

The primary goal of this study is to test the prediction that coexisting species differ in flowering time more than they would if flowering times were assigned to species randomly. To test this, a null model analysis will be used to determine if species are filtered into a target plant community non-randomly with respect to flowering time. Some evidence exists to support the prediction that coexisting species differ in flowering time. However, this theory has not yet been tested using an appropriate community-scale null model and this question has not been explored in sufficient detail to clarify whether general trends exist. The main aim has two parts: (a) is there a rule about how species are organized with respect to flowering time, and (b) if so, are species with similar flowering times found growing in the same plots (neighborhoods) more often than expected by chance or are species with more different flowering times found together more often than expected? The Bee field located at QUBS was chosen for this study. After 50 plots were designated, a list of plant species found in each plot was generated. In total, three plot surveys were conducted during the growing season (May, July and October). Once a species list was generated, 25 individuals (i.e., ramets) of each species were tagged outside the plots. Tagging 25 individuals allowed these species to be monitored throughout the summer to quantify their flowering times. Thirty-nine species were found and tagged. All tagged individuals were monitored for flowering once per week. In the null model used for this study, flowering time overlap among species that reside together in the same plots is compared to a distribution of patterns that would be observed if flowering time was assigned to species randomly.

Assistants: Sarah Dombrowskie, Amanda Tracie

Acknowledgements: Funded by NSERC discovery grant to LWA.

Theses (involving work done at QUBS):

Dombrowskie, S. 2009. The leaf size / number trade-off within species and within trees for woody angiosperms. BSc.(Hons.) Thesis, Queen's.
Scott, S.L. 2009. Characterizing the leaf size/number trade-off at different scales. MSc. Thesis, Queen's University.

Publications – last two years (involving work done at QUBS):

Schamp, B.S., Chau, J. and Aarssen, L.W. (2008) Dispersion of traits related to competitive ability in an old-field plant community. *Journal of Ecology* 96: 204-212.
Chambers, J. and L. W. Aarssen. (2009) Offspring for the next generation: most are produced by small plants within herbaceous populations. *Evolutionary Ecology* 23:737–751.
Schamp, B.S. and L.W. Aarssen (2009) The assembly of forest communities according to maximum species height along resource and disturbance gradients. *Oikos* 18: 564-572.
Whitman, T. and Aarssen, L.W. 2009. The leaf size/number trade-off in herbaceous angiosperms. *Journal of Plant Ecology* (in press). doi: 10.1093/jpe/rtp018.
Schamp, B.S. and Aarssen, L.W. (in press). The role of plant species size in invasibility: a field experiment. *Oecologia* (in press).

Dr. Robert Arlinghaus – Inland Fisheries Lab, Humboldt University at Berlin, Germany

“Effects of Angling on Largemouth Bass”

Research was conducted using the telemetry array at Warner lake. The goal of the project is to identify the behavioural correlates of vulnerability to angling in largemouth bass (*Micropterus salmoides*). In collaboration with Prof Dr Steven Cooke and his students we captured and tagged N = 50 adult largemouth bass and stocked them into Warner lake. Current work in 2009 and 2010 include behavioural characterization and catchability assessment to angling gear.

PIs: Robert Arlinghaus (IGB, Berlin, Germany) and **Steven Cooke** (Carleton University)

PhD student: Thomas Klefoth (IGB, Germany)

MSc student: Katrina Cook (Carleton University)

Publications:

Arlinghaus, R., T. Klefoth, S.J. Cooke, A. Gingerich, C.J. Suski. 2009. Physiological and behavioural consequences of catch-and-release angling on northern pike (*Esox lucius*). Fisheries Research, 97, 223-233.

Arlinghaus, R., T. Klefoth, A. J. Gingerich, M. R. Donaldson, K. C. Hanson, S.J. Cooke. 2008. Behaviour and survival of pike, *Esox lucius*, with a retained lure in the lower jaw. Fisheries Management and Ecology, 15, 459-466.

Arlinghaus, R., T. Klefoth, A. Kobler, S.J. Cooke. 2008. Size-selectivity, capture efficiency, injury, handling time and determinants of initial hooking mortality of angled northern pike (*Esox lucius* L.): the influence of bait type and size. North American Journal of Fisheries Management, 28:123-134.

Dr. Gabriel Blouin-Demers - Department of Biology, University of Ottawa, Ottawa

“Behavioural and physiological ecology of reptiles”

Our long-term research objective is to decipher how behaviour and phenotype, modulated by physiological constraints, affect whole-organism performance and, thus, fitness-related life-history traits. We use a functional evolutionary approach and most of our work integrates controlled laboratory experiments with field observations.

Because reptiles are, proportionally, the most threatened vertebrate group in Canada (according to COSEWIC listings), another long-term objective in our laboratory is to contribute to their conservation. While we use funding other than NSERC to conduct applied conservation projects on reptiles at risk (e.g., descriptions of habitat use and movement patterns), we are also interested in fundamental conservation questions, such as the implications of demographic synchrony and of anthropogenic mortality.

In spring 2009, we continued our long-term demographic monitoring of the ratsnake population.

Assistants: Ariane and Félix Blouin, Grégory Bulté, Isabelle Ceillier

Grégory Bulté - “Causes and consequences of sexual size dimorphism in the common map turtle (*Graptemys geographica*)” - PhD Thesis

Map turtles (*Graptemys*) are among the most size dimorphic reptiles. Females can be twice the length of males and up to ten times the mass. In the common map turtle, diet dimorphism in size and type of prey consumed is also present. For my PhD, I am interested in the following questions:

1-How do growth rates and timing of maturation differ between the sexes?

2-How does variation in growth rates between the sexes influences investment in thermoregulation and vice-versa?

3-Is body size sexually selected in males and females?

4-Is there a functional link between diet dimorphism and size dimorphism? Is allometric head size enlargement and foraging specialization in females necessary to achieve larger body size?

To answer these questions, I integrate physiology, ecology and behaviour. I use physiological telemetry, molecular markers, stable isotopes analysis, and mark-recapture techniques to gather my data. In spring 2007, I wrapped up the field component of my study by continuing the mark-recapture program and removing radio-transmitters previously placed on turtles.

Assistant: Isabelle Ceillier

Publications:

Bulté G & G Blouin-Demers. 2008. Northern map turtles (*Graptemys geographica*) derive energy from the pelagic pathway through predation on zebra mussels (*Dreissena polymorpha*). *Freshwater Biology* 53: 497-508.

Ben-Ezra E, G Bulté & G Blouin-Demers. 2008. Are locomotor performances co-adapted to preferred basking temperature in the northern map turtle (*Graptemys geographica*)? *Journal of Herpetology* 42: 322-331.

Blouin-Demers G & PJ Weatherhead. 2008. Habitat use is linked to components of fitness through the temperature-dependence of performance in ratsnakes (*Elaphe obsoleta*). *Israel Journal of Ecology & Evolution* 54: 361-372.

Bulté G, DJ Irschick & G Blouin-Demers. 2008. The reproductive role hypothesis explains trophic morphology dimorphism in the northern map turtle. *Functional Ecology* 22: 824-830.

Patterson LD & G Blouin-Demers. 2008. The effect of constant and fluctuating incubation temperatures on the phenotype of black ratsnakes (*Elaphe obsoleta*). *Canadian Journal of Zoology* 86: 882-889.

Bulté G, MA Gravel & G Blouin-Demers. 2008. Sexual dimorphism and intersexual niche divergence in northern map turtles (*Graptemys geographica*): the roles of diet and habitat use. *Canadian Journal of Zoology* 86: 1235-1243.

Carrière MA, Bulté G & G Blouin-Demers. 2009. Spatial ecology of northern map turtles (*Graptemys geographica*) in a lotic and a lentic habitat. *Journal of Herpetology*, in press.

Bulté G & G Blouin-Demers. 2009. Does sexual bimaturation affect the cost of growth and the operational sex ratio in an extremely size dimorphic reptile? *Écoscience* 16: 175-182.

Bulté G, Carrière MA & G Blouin-Demers. 2009. Impact of recreational power boating on two populations of northern map turtles (*Graptemys geographica*). *Aquatic Conservation: Marine and Freshwater Ecosystems*, in press.

Bulté G & G Blouin-Demers. 2009. Implications of extreme sexual size dimorphism for thermoregulation in a freshwater turtle. *Oecologia*, in press.

Sperry JH, G Blouin-Demers, GLF Carfagno & PJ Weatherhead. 2009. Latitudinal variation in seasonal activity and mortality in ratsnakes (*Elaphe obsoleta*). *Ecology*, in press.

Theses:

Bulté G. 2009. Sexual dimorphism in northern map turtles (*Graptemys geographica*): Ecological causes and consequences. PhD Thesis, Department of Biology, University of Ottawa.

Dr. Frances Bonier – Department of Biology, Queen's University

“Field endocrine studies of tree swallows”

Our research focuses on causal and correlative relationships between environmental challenges, hormonal responses, and reproductive success in tree swallows. In previous years we documented natural correlations between these parameters, with stress hormone levels measured early in breeding negatively correlating with reproductive success, while hormone measures collected late in the breeding effort positively correlate with reproductive success. This year we continued collecting correlative data from all of the tree swallows breeding in nest boxes at QUBS, and also conducted a pilot study aimed at testing the hypothesis that the energetic demands of the birds' reproductive investment (i.e., the cost of caring for and feeding the brood) actually cause increases in stress hormones in the parents, leading to the observed positive relationship between these hormones and reproductive success. Those birds with larger broods work harder to feed them, but also fledge more offspring, leading to both high stress hormone levels and high reproductive success. We tested this hypothesis by attempting to reduce the energetic demands of rearing offspring through providing supplemental food directly to nestling tree swallows. We predict that with supplemental food, the adults should not have to work quite so hard to provision their broods, leading to a reduction in their stress hormone levels.

Assistants: Dana Drumm, Ainsley McGregor

Dr. Steven J. Cooke - Fish Ecology and Conservation Physiology Laboratory, Department of Biology and Institute of Environmental Science, Carleton University

“Fish ecology and conservation physiology”

Our laboratory maintains broad interests in all aspects of aquatic ecology, conservation biology, physiological ecology, animal behaviour and environmental science. Much of our research programme is based at QUBS where freshwater fishes are used as research models for experiments conducted in laboratory tanks, enclosures, and experimental lakes. Specific interests are (1) determining the energetic, fitness, and potential evolutionary consequences of a variety of natural (e.g., winter, reproduction) and anthropogenic (e.g., angling, environmental pollution) stressors and, (2) understanding the diversity of energetic, physiological, and behavioural responses of fish to stress at the individual, population, and species level. We then apply the fundamental knowledge derived from these basic research activities to aid in the conservation and management of aquatic resources. Of late, we have been involved with defining the new discipline of “conservation physiology” – a field dedicated to understanding the mechanisms underlying conservation problems. Because our work is heavily based in the field, we rely on technologies including underwater videography and telemetry to monitor free-swimming fish in the wild. Specific research projects currently underway at QUBS include evaluating the sublethal consequences of catch-and-release angling, exploring ecology of stress in wild fish (our NSERC-funded research programme), and understanding the factors influencing the spatial ecology of fish.

Dr. Tom Binder – “Metabolic correlates of boldness in bluegill sunfish” – Post-doctoral Fellow

Tom joined our laboratory as a postdoctoral fellow in the spring of 2009. His research this summer focused on understanding how metabolic differences relate to boldness in fishes, using bluegill sunfish as a model. In particular, he is interested in determining whether shy and bold fish differ in their capacity to perform and recover from aerobic and anaerobic locomotor activity. This work is a collaborative project with Alex Wilson (Carleton University) and Dr. Cory Suski (University of Illinois). The study will continue next summer.

Connie O'Connor - "Life history mediators of the endocrine stress response" - Ph.D. Thesis

This was the third year of the Ph.D. programme for Connie O'Connor. Her research focused on the link between physiology and life history in wild smallmouth bass, and evaluated whether the endocrine response to a standard stressor is influenced by the life history of the individual fish. Connie worked primarily on Miller's Lake, with some additional work conducted on Charleston Lake, Big Rideau Lake, and Sand Lake, and was assisted by other team members. This research has resulted in two manuscripts. The first is in preparation for the journal "General and Comparative Endocrinology" and the second is in preparation for the journal "Proceedings of the Royal Society of London."

Sean Landsman – "Physiological and behavioral effects of catch-and-release angling on muskie" – M.Sc. Thesis

Sean is a new Masters student studying the effects of catch-and-release angling on muskellunge using the Rideau and Ottawa Rivers as study sites. Prior to the commencement of his first full field season, Sean used the facilities at QUBS to organize materials necessary for his project. Once everything was assembled he moved to Ottawa where he could be closer to his study sites.

Marie-Ange Gravel – "Individual and intergenerational causes and consequences of nest predation pressure" – Ph.D. Thesis

This was the 3rd field season for Marie-Ange's Ph.D. thesis. This work focused on the nest guarding behaviour and physiology of nesting smallmouth bass across 6 lakes with a natural gradient of nest predation pressure (Big Rideau Lake, Charleston Lake, Indian Lake, Newboro Lake, Opinicon Lake and Sand Lake) near and around the Biology Station. This year, internal electromyogram tags (EMG) were surgically implanted into 6 fish from Opinicon Lake and 8 fish from Big Rideau Lake. These tags provide information on fish activity and permit comparisons between the behaviour of guarding males between a lake with high predation pressure and low predation pressure. Marie-Ange also collected larvae and developing offspring from these lakes to examine if they differ physiologically and behaviorally across a natural gradient of predation pressure. In collaboration with Dr. Cory Suski (University of Illinois at Urbana-Champaign), this work examined the post-exercise oxygen consumption of larval smallmouth bass. Marie-Ange is supported through a NSERC scholarship.

Alison Colotelo – "Condition and Fate of Fish Bycatch Captured in Inland Commercial Fisheries" – M.Sc. Thesis

In collaboration with Ontario Ministry of Natural Resources, Fisheries and Oceans Canada and the Ontario Commercial Fishery Association, Alison conducted an extensive study in Newboro Lake, documenting the condition and fate of fish caught as bycatch in the local inland commercial fishery using physiological, behavioural and injury measures. This work also included a telemetry study in Opinicon Lake looking at the short term behaviour and survival of northern pike which are captured as bycatch in this fishery. Graham Raby (M.Sc. student in Cooke Lab) helped extensively with this project and used many of the techniques to investigate the impacts of commercial fisheries on the migration adult Pacific salmon during Fall 2009.

Alison recently completed her M.Sc. degree requirements and is now working as a Research Biologist for Carleton University.

Sarah McConnachie – "The consequences of multiple stressors on the overall condition and immune function of wild bluegill sunfish (*Lepomis macrochirus*)" – M.Sc. Thesis

This was Sarah's first field season as a M.Sc. student in the lab. She performed a suite of experiments, located in tanks on the docks of the QUBS on Opinicon Lake, aimed at determining how multiple stressors influenced the condition and survival of wild bluegill sunfish. Fish were collected from the lake by angling and were subsequently exposed to a standardized stressor and placed in the tanks. After a set time period, fish were exposed to

additional stressors and were then monitored closely for up to a month. The results of this experiment will allow Sarah to determine if the initial stressor allowed for any predictions on how fish would respond to the additional stressors. Sarah was mainly assisted by Laura Chomyshyn, but also received help from all the other members of the group.

Katrina Cook – “The ecological correlates of stress responsiveness” – M.Sc. Thesis

Katrina’s research looked at how fish physiologically respond to stressors in the wild using cortisol, the primary stress hormone in fish, as an indicator of their response. By applying a standardized stressor she was able to compare the variation in responses within and between individuals and determine how this variation relates to behaviour and fitness in the wild. To accomplish this, fifty largemouth bass with radio acoustic tags were stocked into Warner Lake and their behavior and activity levels were observed and future spawning success and survival will be monitored.

Sarah Larocque – “Reduction of freshwater turtle mortality in freshwater commercial fisheries” – M.Sc. Thesis

Sarah has recently started her M.Sc. under the co-supervision of Drs. Steven Cooke and Gabriel Blouin-Demers (University of Ottawa). Her project revolves around reducing freshwater turtle mortality in freshwater commercial fisheries. During the summer, she did some preliminary work on monitoring turtle behaviour whilst in hoop nets and determining the effects of a net modification on turtle physiology. Both Cody Dey and Alex Nagrodski helped with these projects. Sarah is supported through a NSERC scholarship.

Chris Pullen – “Physiological and behavioural impacts of lure retention on northern pike” – M.Sc. Thesis

This two year study, initiated in 2008, aims to study the impacts to fish that break off the line during an angling event and return to the lake with the lure still embedded in the mouth. The study goals are to determine lethal and sub lethal affects of lure retention by evaluating fish physiological condition and behaviour with and without lures. The lab study focused on blood analysis to assess physiological stress indicators, changes in metabolism using respirometry, as well as tank behaviour observations using the wet lab facilities at QUBS. This work was coupled with tracking of fish in Lake Opinicon with retained lures in 2009. For the tracking component, floating lures fitted with radio transmitters were used to facilitate lure retrieval from around the lake. The results shed light on duration of lure retention as a result of various hooking morphologies as well as fish movements with and without lures. This study will contribute to enhanced management of recreation fisheries.

Cody Dey - Behavioural and Physiological Consequences of Exogenous Hormone Manipulations in Smallmouth Bass during Parental Care – B.Sc. Thesis

Cody investigated hormone mediation of parental care intensity of male smallmouth bass by manipulating cortisol and androgens through slow release implants of various pharmacological agents. Furthermore, he examined whether predicted changes in behaviour were a result of energetic costs by measuring plasma biochemical indicators of nutritional status. This work was conducted with guidance from Constance O’Connor and will be submitted for publication to *Hormones and Behaviour*. This is a collaborative project with Dr. Kathleen Gilmour (University of Ottawa).

Justin Robert – “Consequences of hook retention across a variety gear styles/sizes in bluegill sunfish – B.Sc. Thesis

In an attempt to further our understanding into the implications of deep hooking in catch-and-release angling, Justin conducted a study to address the relative consequences of different hook styles and sizes which deep hooked fish and the line was cut. This study is in accordance with previous research at QUBS, which concluded that “cutting

the line” would relay the greatest survivorship amongst fish who were deeply hooked, but only accounted for one standardized gear type.

Laura Chomyshyn- “Aseptic Techniques and Pathogen Exposure During Surgery in Adult Bluegill Sunfish” – B.Sc. Thesis

Laura’s study took place on Lake Opinicon and consisted of examining the effects of varying degrees of sterility during surgery. Varying degrees defined as 1) sterile, 2) field conditions, and 3) no aseptic conditions. Another portion of my work at QUBS focused on pathogen exposure via water entering the incision point during surgery, and its effect. Multiple water rinses were used such as; distilled, lake and saline water as well as a test group that remained water rinse free. This work was conducted with guidance from Sarah McConnachie.

Samantha Wilson – “Oxidative stress as a consequence of parental care in smallmouth bass” – B.Sc. Thesis

Samantha Wilson conducted her undergraduate thesis work with our lab throughout spring of 2009. Her work focused on parental care provided by the male smallmouth bass throughout the development of their fry. More specifically, her work concentrated on the development of oxidative stress that may have resulted from increased aerobic and anaerobic respiration as a consequence of provision of parental care. Essentially she asked the questions “Does provision of parental care cause oxidative stress in the male smallmouth bass?” and “Is oxidative stress, resulting from parental care, affected by predator burden of nesting area?” These samples are currently being analyzed in the laboratory. This work was conducted with guidance from Marie-Ange Gravel and is a collaboration with Dr. Bill Wilmore (Carleton University).

Assistants: Alex Nagrodski, Patricia Halinowski, Liane Nowell, Julie Weatherhead

Publications:

- Henry, N.A., S.J. Cooke, and K.C. Hanson. 2009. Consequences of fishing lure retention on the behaviour and physiology of free-swimming smallmouth bass during the reproductive period. *Fisheries Research* 00:000-000.
- Hanson, K.C., and S.J. Cooke. 2009. Why does size matter? A test of the benefits of female mate choice in a teleost fish. *Physiological and Biochemical Zoology* 82: 617-624.
- O'Connor, C., K.M. Gilmour, R. Arlinghaus, G. Van Der Kraak, and S.J. Cooke. 2009. Stress and parental care in a wild teleost fish: Insights from exogenous supraphysiological cortisol implants. *Physiological and Biochemical Zoology* 82: 709-719.
- Hasler, C.T., C.D. Suski, K.C. Hanson, S.J. Cooke, D.P. Philipp, and B.L. Tufts. 2009. Effect of water temperature on laboratory swimming performance and natural activity levels of adult largemouth bass. *Canadian Journal of Zoology* 87: 589-596.
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- Gravel, M-A., and S.J. Cooke. 2009. Influence of inter-lake variation in natural nest predator burden on the parental care behaviour of smallmouth bass (*Micropterus dolomieu*). *Ethology* 115: 608-616.
- Arlinghaus, R., T. Klefoth, S.J. Cooke, A. Gingerich, and C.D. Suski. 2009. A combined laboratory and field study to understand physiological and behavioral disturbance and recovery from catch-and-release recreational angling in northern pike (*Esox lucius*). *Fisheries Research* 97: 223-233.
- Hanson, K.C., C.M. O'Connor, G. Van Der Kraak, and S.J. Cooke. 2009. The relative roles of parental investment and organismal condition in parental aggression in smallmouth bass. *Hormones and Behaviour* 55: 495-499.
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- Hanson, K.C., and S.J. Cooke. 2009. Nutritional condition and physiology of paternal care in two congeneric species of black bass (*Micropterus* spp.) relative to stage of offspring development. *Journal of Comparative Physiology B* 179: 253-266.
- Hasler, C.T., C.D. Suski, K.C. Hanson, S.J. Cooke, and B.L. Tufts. 2009. The influence of dissolved oxygen on winter habitat selection by largemouth bass: an integration of field biotelemetry studies and laboratory experiments. *Physiological and Biochemical Zoology* 82: 143-152.

Dr. Christopher G. Eckert - Department of Biology, Queen's University.

"Plant mating system evolution"

We are interested in the evolution and maintenance of mixed mating in the red columbine *Aquilegia canadensis*. The high inbreeding depression estimates renders hypotheses invoking reproductive assurance unlikely. Current work investigates the mating patterns and fitness consequences of mixed mating for all reproductive-fitness components using newly developed microsatellite markers.

Andy Y.-C. Wong - "Cost-benefit analysis of mixed mating in *Aquilegia canadensis* (Ranunculaceae)" - Ph.D. Thesis

Mixed mating remains unexplained in *A. canadensis* because high inbreeding depression should select for a primarily outcrossing mating system. Herkogamy (separation between anther and stigma) is mostly likely to evolve because it has large standing variation within populations and has had large fitness consequences in other flowering plants. Natural selection should favor large herkogamy; however the *A. canadensis* populations seems to be constrained and maintains large variation in herkogamy. This question can be addressed by a cost-benefit analysis that estimates all reproductive fitness components (selfing, outcross male and outcross female). If we find contrasting selection via different fitness components, it may explain the maintenance of high variation in herkogamy in *A. canadensis*.

Assistants: Carolynne Brikis.

Acknowledgements: NSERC discovery grant to CGE.

Publications:

- Eckert, C.G., B. Ozimec, C.R. Herlihy, C.A. Griffin & M.B. Routley. 2009. Floral morphology mediates temporal variation in the mating system of a self-compatible plant. *Ecology* 90: 1540-1548.
- Herlihy, C.R. & C.G. Eckert. 2007. Evolutionary analysis of a key floral trait and its effect on the mating system in *Aquilegia canadensis* (Ranunculaceae). *Evolution* 61: 1661-1674

Thesis:

- Sagar, S.P. (2009) Spatial structuring of genetic vs. morphological variation in *Aquilegia canadensis* (Ranunculaceae). B.Sc. Honours Thesis, Queen's University.

Dr. Mark Forbes - Department of Biology, Carleton University, Ottawa

"Ecological Parasitology"

I continued to work on some of my long term research goals in the areas of parasite-host interactions and intra-specific variation in ecology and behaviour. Summaries of this work are covered elsewhere in this report.

Dr. Laura Nagel - Postdoctoral Fellow, Forbes Lab, Carleton University

“ Fitness impacts of parasites”

My research with Dr. Mark R Forbes focuses on the role of natural selection in host-parasite interactions. I am interested in the fitness impacts of parasites, host adaptive responses, and the evolution of local adaptation and specialization. I use natural populations of Odonates (dragonflies and damselflies) and ectoparasitic aquatic mites. I began working at QUBS in the summer of 2008 to continue work initiated by Dr. Tonia Robb on long-term patterns of parasitism and host defence for a damselfly-parasitic water mite association found at Barb's Marsh. We are also collecting mites for future genetic analysis to examine local adaptation in mites.

Assistants: Jen Campbell, Haydee Peralta, Olivia Rudin

Michelle Zanuttig – “Influence of external and internal parasites on the predation of damselfly hosts by dragonflies” – M.Sc. thesis

This project is focused on the influence of ectoparasitic larval water mites and intestinal gregarine parasites on host flight ability and whether parasitism increases encounter rates of damselfly hosts with dragonfly predators. June and July of 2008 and 2009 were spent conducting a number of flight ability trials, which included recording distance flown by the host upon release, and time spent flying in cages. We also examined the impact of dragonfly predation on larval water mites, ectoparasitic on host (prey) damselflies. This was done by feeding parasitized and unparasitized damselflies to dragonfly predators; mite escape responses were recorded, as well as the feeding behavior of the dragonflies.

Assistants: Jen Campbell, Haydee Peralta, Olivia Rudin

Publications:

- Nagel, L., T. Robb and M.R. Forbes. 2009. Parasite-mediated selection amidst marked inter-annual variation in mite parasitism and damselfly life history traits. *Ecoscience* 16 (2): 265-270
- Forbes MR, Robb T. 2008. Testing hypotheses about parasite-mediated selection using odonate hosts. pp. 175-188 In: *Dragonflies: Model Organisms for Ecological and Evolutionary Research* edited by Alex Córdoba-Aguilar. Oxford University Press.
- Norman K, Cappuccino N, Forbes MR. Effect of host and site characteristics on parasitism of a successful weed biological control agent, *Galerucella californiensis*. *Can Entomol*, In press
- Nagel L, Robb T, Forbes MR. 2009. [Parasite-mediated selection amidst marked inter-annual variation in mite parasitism and damselfly life history traits](#) *Écoscience*, 16:265-270
- Dare OK, Forbes, MR. 2009. Patterns of infection by lungworms, *Rhabdium ranarum* and *Haematolechus* spp. in Northern Leopard Frogs: a relationship between sex and parasitism *Journal of Parasitology* 95:275-280
- Dare OD, Forbes, MR. Patterns of trematode and nematode lungworm infections in northern leopard frogs and wood frogs from Ontario, Canada. *J Helminthology*, in press
- Iserbyt A, Bots J, Ting JJ, Jvostov FP, Forbes MR, Sherratt TN, Van Gossum H. 2009. Multi-annual variation in female morph frequencies of the polymorphic damselfly, *Nehalennia irene*, at continental and regional scales. *Animal Biology*
- James, JA, Bert, DG, Forbes, MR. 2009. Ectoparasitism of damselflies by water mites is higher at natural versus artificial wetlands. *Ecography*, in press.
- Dare, O, Nadler, S, Forbes MR. 2008 Nematode lungworms of two anuran amphibians: evidence for coadaptation. *International Journal for Parasitology* 38:1729-1736.
- Koprivnikar, J, Forbes, MR, Baker, RL. 2008. Larval amphibian growth and development under varying density: are parasitized individuals poor competitors? *Oecologia* 155:641-649.
- Dare, O, Forbes, MR. 2008. Rates of development in male and female Wood Frogs and patterns of parasitism by lung nematodes. *Parasitology* 135:385-393.

Van Gossum, H. Robb, T, Forbes MR, Rasmussen, L. 2008. Female-limited polymorphism in a widespread damselfly: morph frequencies, male density and phenotypic similarity of andromorphs to males. Canadian Journal of Zoology 86:1131-1138.

James H. Fullard - Department of Biology, University of Toronto Mississauga

“Sensory ecology and neuroethology of insects and bats”

Matt Jackson – “Biophysics of the dioptine ear” - Ph.D. candidate

In the summer of 2009 the first project that I ran examined how the cavity volume in an insect ear influenced tuning, or the frequencies of sound to which it is most sensitive. I used a notodontid moth in the subfamily Dioprinae whose ear has an exaggerated external accessory structure. This bulge in the ear “drum” could be manipulated to change the volume of the cavity. By comparing the tuning curves of untouched, manipulated and sham treated ears I will determine to what degree the volume of a tympanic cavity influences auditory sensitivity in moth ears.

Assistants: Navdeep Asi and James Siberry Saunders

Matt Jackson - A new method for computing audiograms

For the last three summers I have been collecting auditory sensitivity curves of notodontid moths wild caught at QUBS, using a new automated method that I assisted in developing. Because the entire output of the sensory cell is recorded digitally the data can be analyzed in greater depth than previously possible. Audiograms based on new definitions of threshold will be compared to previously published audiograms of the same species, obtained by older methods that used different definitions of threshold.

Matt Jackson – “ Free-flight responses in moths to bat-like sounds”

This summer I also built a large indoor flight cage in which I flew eared noctuid moths that were caught at black lights around the QUBS campus. The cage was filmed by in stereo, which allowed for three dimensional reconstructions of flight paths. As moths flew past a speaker they were presented with bat-like ultrasound in order to establish the intensity at which they respond to these sounds as well as the nature of these evasive manoeuvres. This information will allow me to correlate sensory neural activity to the avoidance behaviour of moths to echolocating bats.

Assistants: Line Faber Johanassen, James Siberry Saunders and Navdeep Asi

Navdeep Asi - “Effects of Rise/Decay times and frequency composition of synthetic bat calls on the auditory response of the AN2 interneuron” - M.Sc. candidate

This summer I examined the effects that changes in rise and decay times had on the neural response of the auditory AN2 interneuron in the cricket *Teleogryllus oceanicus*. In addition, I looked at the effect that frequency composition had on the AN2 response. The AN2 interneuron functions as a bat detector for this cricket eliciting escape behaviours if stimulated at sufficient rates. For echolocation calls, rise time refers to the time it takes the signal to reach maximum amplitude and decay time refers to the drop from maximum amplitude to resting state. The frequency composition of bat calls was compared by examining the response to constant frequency echolocation calls or frequency modulated echolocation calls. It is hypothesized that increases to rise and decay times will decrease the neural response of the AN2 interneuron, thus making the cricket more susceptible to predation by bats. Additionally, echolocation calls with a smaller bandwidth signal (i.e., constant frequency calls) will produce a weaker AN2 neural response as high bandwidth signals (i.e., frequency modulated calls) will trigger firing in a greater population of auditory receptors.

Assistants: James Saunders, Line Faber Johanassen

Navdeep Asi – “Re-examining behavioural threshold in the AN2 interneuron”

In order to determine the behavioural relevance of changes in the AN2 response to changes in rise/decay times and frequency composition, I re-estimated the behavioural threshold required to elicit escape behaviours. Previous studies have shown that only when the AN2 fired at a critical rate of 220 Hz were escape behaviours elicited. However, this was established as an average firing pattern over 100 ms. As bats do not typically echolocate with durations this large, a new estimate is required. In order to re-estimate this behavioural threshold, I looked at the instantaneous firing rate (ISR) of the threshold response. Using the ISR will provide a much clearer picture of the true firing rate required to elicit escape behaviours. Additionally, using the ISR is more indicative of how post-synaptic cells will be stimulated.

Assistants: James Saunders, Line Faber Johanassen

Hannah Moir – “ Auditory examination of moths” - Ph.D. candidate –Department of Electrical and Electronic Engineering, University of Strathclyde with Dr. James Windmill

During the summer of 2009 I visited the laboratory group of Prof. James Fullard; the purpose of the trip was to learn the micro-dissection of moths and the electrophysiological techniques in order to record the neural activity of the tympanic nerve when stimulated with sound. My research involves combining the study of the extremely sensitive tympanal organs of insects and applying it to the design of new acoustic sensor technology. The techniques learnt at QUBS will be used in research projects next summer at the University of Strathclyde using a laser Doppler vibrometer to record the mechanical displacements of the membrane whilst simultaneously recording the neural activity of the auditory nerve of moths. During my time spent at QUBS the ventral and dorsal dissections of moths were mastered. Preliminary research of the B cell response when the wing position was altered were also carried out to investigate the function of the B cell as a proprioceptor, as the B cell does not react to sound stimulus, this project will be further developed next summer at Strathclyde.

Line Faber Johannesen –“Recording bats on multiple microphones in order to calibrate for absolute intensity” - University of Southern Denmark

I spent July and August at QUBS working as an assistant for Ph.D. student Matt Jackson. I collected moths for Matt to use in his flight cage and for audiograms. Since I, in Denmark, work with bats at the University of southern Denmark, I went to record bats at a local church in Portland, Ontario where they had problems with bats and wanted to identify the species. We identified them as the little brown bat, *Myotis lucifugus*, and we caught four of them with harp traps. The reason why we caught the bats was that we wanted to get some recordings of the bats' approach and feeding buzz calls, so we could play these sounds back to the moths we collected and flew in the indoor flight cage. So I designed an array for microphones that would allow us to calibrate for absolute intensity of the calls, and once we finished building it, we started recording bats at the outdoor flight cage at QUBS. We tethered a moth approximately in the middle of the flight cage and got one bat at a time to attack the moth and recorded the calls with three different microphones set at different gain settings. These recordings will be played for the moths in an indoor flight cage and their response, which will hopefully be evasive flight manoeuvres, to the ultrasonic echolocation calls will be reconstructed three dimensionally. These recordings will make it possible to determine if there is a difference in the way the moths react to bat calls depending on the differences in intensity between approach calls and a feeding buzz call.

Publications:

Asi NS, Fullard JH, Whitehead, S, Dawson, JW. (2009) No neural evidence for dynamic auditory tuning of the A1 receptor in the ear of the noctuid moth, *Noctua pronuba*. *Journal of Comparative Physiology A*.

Dr. Jean-Guy Godin - Department of Biology, Carleton University

“Behavioural Ecology of Fishes”

My research lab maintains relatively broad interests in Behavioural Ecology. Natural variation in biological traits is necessary for the action of natural and sexual selection. A longstanding challenge in Evolutionary Ecology has been to understand how variation in traits that are under selection, including behaviour, is maintained in the wild. In this context, the long-term, general objective of my research programme is to contribute to a more comprehensive understanding of how natural and sexual selection are mediated by ecological and social factors and their roles in shaping and maintaining variation in behaviour within populations. This research programme combines both the experimental and comparative approaches, field and laboratory work, and the use of mathematical modeling, microsatellite genotyping methodology, and computer-based video technologies to address functional and mechanistic questions about the evolution of behaviour. My research laboratory uses a variety of different species (primarily fishes, but not exclusively) as model study systems as appropriate. Three general and broad areas of inquiry are currently being pursued in collaboration with students, postdoctoral fellows and colleagues: (i) sexual selection and mating strategies and tactics, (ii) group living and social associations, and (iii) the behavioural ecology of predator-prey interactions. We conduct our research locally and abroad (Trinidad and Costa Rica). Work carried out at QUBS is presently limited to the research of one of my doctoral students (Alexander Wilson).

Alexander Wilson — “The behavioural ecology of boldness in fishes” (Ph.D. thesis)

During June and July 2008, we investigated whether recreational angling preferentially targets shy or bold individual bluegill sunfish (*Lepomis macrochirus*) based on their behavioural phenotype. We captured from Lake Opinicon about 200 individual fish of both sexes using a beach seine and angling and then quantified their shy-bold behaviour in the laboratory under standardized experimental conditions. We tested seined individuals in large outdoor tanks at QUBS for their susceptibility to being angled and to determine if the location of their capture was influenced by their boldness behaviour. The data are currently being analyzed. This particular project was carried out in collaboration with Drs. Steven Cooke and Tom Binder of Carleton University.

Dr. Paul Grogan - Department of Biology, Queen’s University

“Nutrient Cycling”

Our overall goal is to understand the factors that control carbon and nitrogen cycling and pool sizes in the forests and low intensity agricultural ecosystems of southeastern Ontario. This year, we added a fourth project. In addition, I wrote a document entitled “Soils and Vegetation in the QUBS region” for the Resources section of the QUBS website. Comments and suggestions from Drs. Adele Crowder, Dolf Harmsen and from Dale Kristensen and Floyd Connor were included in the final version.

“Carbon and nitrogen dynamics in abandoned agricultural soils of Southeastern Ontario”

We are investigating the influence of soil type and time on patterns of soil carbon accumulation and nitrogen mineralisation as shrublands and forests regenerate on abandoned agricultural lands across the region. Several fields and forests in the QUBS properties have been included in this study. A manuscript on the carbon aspects of the study is currently in review (Foote and Grogan. Soil carbon accumulation during temperate forest succession on abandoned low productivity agricultural lands. In review *Ecosystems*. Submitted Sept 15th, 2009). A second manuscript on the nitrogen aspects is in draft form.

“The effects of atmospheric nitrogen deposition on plant productivity and nitrogen cycling in hay fields”

We are investigating the influence of nitrogen availability and soil texture on soil microbial community and plant productivity in hay grasslands using annual nitrogen additions to two sections of Stokes Field on the QUBS property. Our purpose is to simulate the potential impacts of ongoing atmospheric nitrogen deposition. The data from the 2008 field course section of Terrestrial Ecosystems (BIOL 416) have been synthesised into a report that will provide the basis for a more substantial study in the future.

“The responses of forest vegetation to protection from deer”

We wish to determine the influence of deer browsing on plant community structure, tree seedling regeneration, soil communities and biogeochemical processes. We checked the integrity of the fences on three occasions.

“The relative importance of water, nutrients and deer herbivory on plant community structure and primary production in mesic hay grasslands”

This project is a collaboration between Dr. Aarssen and myself and will be the first large-scale, long-term test of whether, *in non-arid habitats*, water is the most limiting resource affecting plant competition and community structure and assembly in natural vegetation. We predict that on average, over several years (i.e. including across dry and wet years) water is the most important object of competition and limitation on biomass production in the mesic temperate deciduous forest climatic region of eastern Ontario Canada. In other words, compared with nutrient supplementation, we predict that plain water supplementation within vegetation plots will cause most of the increase in biomass production over control plots. This study will also permit an examination of how this water-limitation effect depends on the effects of deer and small mammal herbivory (using caged versus uncaged plots), and on the effects of between plot variation in local soil water holding capacity (affected by plot elevation, soil texture and soil depth). The experiment was established in the Bracken tract after extensive site visits to all QUBS property early in the summer. Dr. Aarssen took the lead in coordinating and managing the project and field assistants.

Assistants: Dr Linda Cameron (Technician); Dragana Rakic, Max Luke, Amy Angelo and Lilian Mak (all undergraduates)

Dr. Rosemary Knapp - Department of Zoology, University of Oklahoma

“Proximate mechanisms of variation in reproductive behaviour and physiology”

In continuing collaboration with Dr. Bryan Neff (Univ. Western Ontario) and his students, we are addressing various questions related to the role of steroid hormones in mediating reproductive behaviour in male bluegill sunfish. First, we continued our investigation into how steroidogenic enzyme activity varies across males practicing three alternative reproductive tactics. Second, Dr. Neff's M.Sc. student, Chandra Rogers, conducted a study investigating the effects testosterone implants on male paternal behavior. We will additionally investigate the effects of testosterone brain gene expression and on steroidogenesis in these males. Chandra will be visiting my laboratory in December 2009 to learn how to measure androgen levels in the plasma and testis samples we collected. Finally, we collected an additional set of tissues for our ongoing investigation of testicular steroidogenesis in the three male morphs. We continue to work on manuscripts based on previous summers' activities that address additional questions related to the hormonal mediation of mating behavior, sperm production and parental care.

Assistants: at QUBS: Bryan Neff's students; **in Oklahoma:** Ph.D. student: Sharon Carlisle; Undergraduates: John Lukeman; Valerie Miller

Publication:

Neff BD, Knapp R. 2009. Paternity, parental behavior and circulating steroid hormone concentrations in nest-tending male bluegill. *Hormones and Behavior* 56: 239-245.

Dr. Maxim Larrivée - Postdoctoral Fellow - Canadian Facility For Ecoinformatics
Research - Dept. of Biology, University of Ottawa

“Canada Global Change Transect Project”

Global changes, particularly climate change and land use conversion, threaten Canada’s biodiversity. The latest research indicates that climate and land use changes have caused widespread and ongoing shifts in the distribution of Canadian flora and fauna. Accurate predictions of global change impacts are critical to successful future species and habitat conservation.

The Canada Global Change Transect will help test if species distributions are tracking changing land uses and climatic conditions through study of Canada’s butterfly fauna. It will also test and calibrate broad-scale models of butterfly species’ ranges to allow predictions of future impacts of climate and land use change. The CGCT has identified the following possible 12 regional transects:

1. Boreal forest – Tundra ecotone (Yukon)
2. Okanagan Valley (British-Columbia)
3. Southern foothills (Alberta)
4. Red Deer River watershed (Alberta)
5. Grasslands (Saskatchewan)
6. Tall Grass Prairies (Manitoba)
7. Red River watershed (Manitoba)
8. Rideau river watershed (Ontario)
9. Carolinian Forest (Ontario)
10. Abitibi (Québec)
11. Eastern Townships (Québec)
12. Baie-des-Chaleurs (New Brunswick – Québec)

The 12 regional transects of the CGCT will be sampled for butterflies in different field seasons (2009-2011). Site selection maximizes chances of detecting range changes based on extensive availability of historical butterfly records (>50,000 records for 102 selected common species from the Canadian Biodiversity Information Facility (CBIF) website) and predicted species’ range shifts (Canadian Facility for Ecoinformatics Research published models). Sites include variation in land uses (from high intensity to wilderness) and magnitudes of recent climate change (from large to nearly none). Historical climate and land use data have already been obtained from Natural Resources Canada, Statistics Canada’s past Censuses of Agriculture (available through standing agreement with University of Ottawa library), and publications.

Depending on weather, four to five days will be spent observing and where necessary collecting butterflies in each area 3 times over the growing season (spring, early summer, mid summer). The relatively common species will be targeted to keep detection rates high. Butterfly specimens will be collected, identified, and stored when specimens cannot be identified on the wing. Each species record will be donated to CBIF. Every sampling locale will be GPS located (5-7m positional accuracy) and searched for known host plants. We already possess reliable butterfly records (n>50,000) for all target species (but more data may be available from amateur groups).

Our initiative will provide results on the rate at which butterfly species responded to recent land use/climate changes in Canada, empirical tests of the efficiency of spatial models run through time to predict outcomes of recent global change, and build calibrated predictions of their future responses based on observed, past responses. We will use CGCT and historical species observations to measure species’ range shifts in the past 50 years. We will build models of the historical ranges for butterfly species using data on past environmental conditions and Maximum Entropy software.

The main users of our results will be the global change scientific community and regional, provincial, and national policy and decision makers in the fields of environment and sustainable management, and conservation. A major benefit to Canada of this project include the first quantitative tests of species’ potential responsiveness to global change relative to historic baselines, data on biotic consequences of global changes. Other benefits of this work include improved policy direction and provision of uncertainty estimates for global change forecasts, and communication of calibrated predictions for the future of biodiversity in Canada (using a range of scenarios that are central to the Intergovernmental Panel on Climate Change global reports).

Butterfly Survey Methods

Butterflies will be surveyed by standard transects techniques (Pollard and Yates, 1993; Grill and Cleary, 2003; Kerr et al. 2000). At every sampling site along a given 200km transect, sampling will take place between 0930am and 1500pm on days that present conditions favorable to butterfly activity (Pollard and Yates, 1993). Surveys will be done along 200m long transects (Davros et al. 2006; Grill and Cleary, 2003) walked at a pace of 10m/min *to ensure constant sampling effort* (Davros et al. 2006). The timer is stopped only to capture and identify the butterflies, record information, take pictures of the samples and georeference the observation locations. A 3m radius (Kerr et al. 2000) semi-circle will be surveyed around each of 2 observers. Transects have limitations but have been shown to provide accurate information about butterfly composition (Spitzer et al. 1997). Butterflies will be identified in the field, without capture or using a standard butterfly net when needed, then identified and released. The specimens that cannot be identified in the field will be collected using ethyl acetate, put in glassine envelopes and later mounted for identification.

Dr. Stephen Loughheed - Department of Biology, Queen's University

“Diversification in temperate & tropical herpetofauna”

Our NSERC-funded research focuses on the causes and consequences of differentiation among populations across spatial and temporal scales, from single populations to entire species' ranges, and from local differentiation that may accrue over generations to monophyletic lineages that may require 1000s of years to evolve. We use a range of molecular markers and phylogeographic, population genetic and ecological approaches to test hypotheses of the origination and diversification of populations and lineages.

“Climate Change and Anuran Calling Phenology”

Frogs are very sensitive indicators of environmental change. For example, evidence suggests that frogs in northeastern North America have shifted onset of breeding markedly earlier over the last few decades, and also that the ranges of many organisms are moving northward presumably in response to climate change. While these trends are remarkable, they are based on past records that were not originally intended to address such questions, and typically are of such broad resolution that they cannot provide detailed insight into the biology that might underlie such changes in distribution and timing of breeding. In May 2008 we began a long-term project to study directly temporal changes in the onset of male calling (a proxy for breeding) and microclimatic correlates of calling for nine species of frog that occur at the Queen's University Biology Station. In 2008 we put out 11 automated survey stations, each consisting of a digital audio recorder programmed to record choruses at dusk, and a data loggers to measure relative humidity and air temperature. In 2009 (beginning in March) we put out 22 survey stations. We hope these long term data will provide key insights into the proximate factors that control initiation of breeding, the possibility for adaptive responses to changing temperature regimes, and will allow us to better predict responses to continued climate change.

Collaborator: José Antonio Dávila, Instituto de Investigación en Recursos Cinegéticos, Ciudad Castilla-LaMancha, Ciudad Real, Spain.

Field Assistants: Surbhi Jain, Aarani Sivasekaram, Thevishka K.

Dr. Beth MacDougall-Shackleton - Department of Biology, University of Western Ontario

“ Mating signals, genetic variation and disease resistance in songbirds”

Research in my lab focuses on the interactions between mating strategies, disease resistance, and population genetic structure within and among wild songbird populations. Our overall objective is to understand

how mating behaviour and gene flow interact to shape birds' ability to produce healthy offspring. My students and I combine cutting edge genetic and immunological techniques with intensive, long-term field studies of free-living songbirds. To this end, we have studied the breeding biology of song sparrows breeding at the Bracken tract for several years.

In 2009 we expanded the geographic scale of our longterm study, with Yanina Sarquis-Adamson collecting genetic samples from song sparrows breeding in other QUBS properties and farther afield, to conduct genetic assignment tests and identify the source population of birds immigrating to Bracken from elsewhere. These data will inform our research on local adaptation and population connectivity. Jenna Kewin initiated another new research direction, collecting blood samples from our Bracken population to examine individual variation in microbial killing ability. Janet Lapierre used a sixteen-channel acoustic location system to identify patterns of movement and territorial song in male song sparrows, and related differences in territorial strategy to differences in mating success.

Yanina Sarquis-Adamson – “Gene flow, parasite transmission and local adaptation” - MSc/PhD thesis

Population connectivity depends not only on the frequency with which individuals disperse, but also on the relative fitness of dispersing versus philopatric individuals. I collected blood samples from song sparrows at five sites between QUBS and Kingston, for genetic analysis and screening of parasite load, to test the hypothesis that philopatric individuals are better able to control infection by local bloodborne parasites. Analyses are still in progress, but preliminary findings include far stronger genetic structuring among males than females, indicating sex biased dispersal. A side project with Janet Lapierre revealed that males that are infected with bloodborne parasites have simpler song repertoires than their non-infected counterparts. [Assistants: Ainsley Furlonger, Kim Schmidt]

Jenna Kewin – “Genetic diversity, fitness and mating strategies” - MSc thesis

Understanding the evolutionary forces that maintain genetic diversity in natural populations is a major goal in behavioural and evolutionary ecology. I examined heterozygosity-fitness correlations in our focal population of song sparrows, and found that more heterozygous males visited their nestlings significantly more often and were significantly less likely to be cuckolded. Surprisingly, I found that more heterozygous birds were less likely to survive migration and return to their breeding grounds the following year. This suggests a possible trade-off between current and future investment. I also found that while females appear to choose their social mates randomly with respect to relatedness, they are more likely to trade up (or trade out) for compatible genes by seeking extra-pair copulations when they are mated to a genetically similar male. [Assistant: Ainsley Furlonger]

Janet Lapierre - “Birdsong as a multi-component signal” - MSc thesis

Birdsong serves two main functions: defending a territory and attracting mates. In song sparrows, the characteristics that make a song an effective territorial signal (high sharing with neighbouring males) are different from the traits that make song an attractive mating signal (high song complexity, regardless of sharing). Thus, males may be faced with a trade-off: preferentially use their most highly shared song types (territorial defense) or sing all song types equally often (advertise complexity to mates). I used a 16-channel acoustic location system to simultaneously record a network of males interacting in their natural environment with minimal human interference. Contrary to the predictions of the territorial defense hypothesis, males did not preferentially sing their most highly shared song types, even early in the year during territory formation. Combined with paternity data showing an advantage to large repertoire size, these data suggest that males in this population prioritize mate attraction over song matching with rivals.

Assistant: Tyne Baker. **QUBS collaborator:** Dan Mennill. Thank you to Floyd and all the QUBS regulars who helped with the array assembly!

Tyne Baker – ‘Breeding experience and song element sharing’ - BSc thesis

In many birds, song matching with neighbouring males is an important signal of aggressive intent. In time-limited song learners such as song sparrows, first-time breeders (yearling males) can modify their vocal repertoires

to match those of their neighbours while the repertoires of veteran breeders remain fixed. I recorded full song repertoires from first-time and veteran breeding male song sparrows, and am now testing the hypothesis that first-time breeders will match a higher portion of song elements with their immediate neighbours than veteran breeders will. If so, this may reduce the disadvantages associated with lack of prior breeding experience.

Publications:

- Potvin DA & EA MacDougall-Shackleton. In press. Paternal song complexity predicts fledging, but not hatching, offspring sex ratios in song sparrows *Melospiza melodia*. *Wilson Journal of Ornithology*.
- Potvin DA & EA MacDougall-Shackleton. 2009. Parental investment amplifies effects of genetic complementarity on growth rates in song sparrows (*Melospiza melodia*). *Animal Behaviour* 78: 943-948.
- MacDougall-Shackleton SA, L Dindia, AE Newman, DA Potvin, KA Stewart & EA MacDougall-Shackleton. 2009. Stress, song and survival in sparrows. *Biology Letters* 5: 746-748.
- MacDougall-Shackleton EA, KA Stewart, DA Potvin & E Tennenhouse. 2009. The rich get richer: song complexity predicts song element sharing and song output in song sparrows *Melospiza melodia*. *Animal Behaviour* 78: 141-146.
- Hernandez AM, JA Pfaff, EA MacDougall-Shackleton & SA MacDougall-Shackleton. 2009. The development of geographic song preferences in female song sparrows *Melospiza melodia*. *Ethology* 115: 513-521.
- Stewart KA & EA MacDougall-Shackleton. 2008. Local song elements indicate local genotypes and predict physiological condition in song sparrows *Melospiza melodia*. *Biology Letters* 4: 240-242.
- Pfaff JA, L Zanette, SA MacDougall-Shackleton & EA MacDougall-Shackleton. 2007. Song repertoire size varies with HVC volume and is indicative of male quality in song sparrows (*Melospiza melodia*). *Proceedings of the Royal Society of London B* 274: 2035-2040.

Dr. Paul Martin - Department of Biology, Queen's University

“Biodiversity and Speciation in Birds”

We are broadly interested in how biodiversity forms and why biodiversity varies across the globe. We study how populations diverge from one another and adapt to their local environments (Vanya Rohwer), the process of allopatric speciation, how new species come into secondary contact and sympatry to increase local diversity (Mark Conboy), and the evolutionary causes of latitudinal variation in diversity. We also study species of conservation concern, including the Golden-winged Warbler.

Vanya Rohwer - "Local adaptation in nest structure between two populations of Yellow Warbler, *Dendroica petechia*." - M.Sc. thesis

Vanya continued his video-taping and experimental transplanting of nests between QUBS and Churchill, Manitoba, encountering a remarkably late and cold year at Churchill. This year we brought in nestling Yellow Warblers from both QUBS (7 nestlings) and Churchill (8 nestlings) for subsequent breeding experiments in 2010. These experiments will test the basis of differences in nest building behaviours between QUBS and Churchill (substrate availability, plasticity, imprinting, maternal effects through the egg, or genetic effects).

Assistant: Carla Crossman

Carla Crossman - "Variation in passerine nest structure between Churchill, Manitoba and QUBS." - Honours thesis

In addition to helping with comparisons of Yellow Warblers, Carla broadened our study of nest structure to include American Robin, Savannah Sparrow, and two *Carduelis* finches (Common Redpoll and American Goldfinch). Carla will measure and dissect nests from QUBS and Churchill this fall, to test the idea that nests are consistently larger across species at Churchill, Manitoba.

Mark Conboy - "Ecological differentiation and coexistence in *Dendroica* warblers." - M.Sc. thesis

Mark completed his final season examining spatial patterns of occurrence and habitat use in sympatric *Dendroica* warblers at QUBS. In addition to this work, Mark completed almost 100 point counts of all birds in 2008 and 2009 covering a large proportion of the properties at QUBS.

Assistants: Daniele Mitchell

Additional Projects

"Behavioural responses of Pine Warblers to two song types of Yellow-rumped Warblers."

Using song playback experiments, we documented aggressive responses of territorial male Pine Warblers to the songs of Yellow-rumped Warblers with which they commonly co-occur. Like many other wood warblers, Yellow-rumped Warblers sing two song types: the first song type is commonly sung by unpaired males and paired males accompanying females, while the second song type is commonly sung after pairing and in male-male interactions. We are presently testing whether male Pine Warblers respond differently to the two song types of Yellow-rumped Warblers, as might be expected if Pine Warbler response to song is adaptive.

Collaborators: Mark Conboy (Queen's), Dr. Frances Bonier (Queen's)

"Latitudinal variation in the loss of species recognition in birds."

A variety of evidence suggests that rates of speciation are highest near the equator. Paradoxically, molecular and phenotypic evidence suggest that phenotypic evolution may be faster at higher latitudes. We are performing a series of behavioural song playback experiments on closely-related temperate and tropical birds to ask the question, at what point of divergence do birds no longer recognize songs as conspecific, and does this occur more rapidly in temperate taxa? This year we completed experiments on male Black-throated Green Warblers, and began experiments on male Veery for comparison with experiments on Spectacled Whitestart and Slaty-backed Nightingale-Thrush, respectively, in Ecuador.

Collaborators: Julie Castner (Virginia Tech), Robert Dobbs (Queen's), Dr. Steve Loughheed (Queen's), Dr. Ignacio Moore (Virginia Tech)

Publications:

King, L.E., V.J. Emery, R.J. Robertson, R. Vallender and P.R. Martin. 2009. Population densities of Golden-winged Warbler, Blue-winged Warbler and their hybrids, in eastern Ontario. *Ontario Birds* 27:2-22.

Theses:

Law, James. 2009. Between North and South: Examining Nest Differences between Two Populations of Yellow Warblers, *Dendroica petechia*. Honours Thesis, Queen's University.

Patrick, Allison. 2009. Evidence for Individual Consistency and Small-scale Location Effects on Nest Morphology in a Population of Yellow Warblers (*Dendroica petechia*). Honours Thesis, Queen's University.

Stirrett-Wood, George. 2009. Interspecific Aggression in Sympatric Parulidae Warblers. Honours Thesis, Queen's University.

Dr. Daniel Mennill - Department of Biological Sciences, University of Windsor

"Behavioural ecology and communication in birds"

Research in the Mennill Lab focuses on acoustic communication in birds and the relationship between avian vocal behaviour and avian reproductive behaviour. We use a field-based approach to studying both temperate and tropical birds, using state-of-the-art digital recording technology to record avian vocal behaviour. Details of our ongoing research projects, including recordings of birds at QUBS, are available at www.uwindsor.ca/dmennill.

In 2009, we continued field studies of Common Loons focusing on communication networks and long distance communication. We also began a new project studying vocal behaviour and mate choice Black-capped Chickadees.

Postdoctoral Fellow: David Wilson

Master's Student: Van La

Field Technicians: Natalie Bond, Leanne Wilson

David Wilson – “Reproductive ecology of black-capped chickadees” – Postdoctoral Research

During the breeding season, male black-capped chickadees engage in singing contests that function in territory maintenance. In addition to this primary function, contests also provide eavesdropping neighbours with valuable information about the quality of individual contestants. Remarkably, information garnered through eavesdropping has a strong effect on the reproductive behaviour of eavesdropping individuals, as it influences both the frequency and distribution of extrapair copulations. My research explores the mechanisms underlying this relationship, and seeks to understand whether the reproductive consequences of eavesdropping are controlled by promiscuous females seeking extrapair copulations with neighbouring males, or by neighbouring males intruding into adjacent territories in search of receptive females. To distinguish between these two alternatives, I study a population of more than 200 marked chickadees that reside at QUBS. The research involves winter fieldwork (January–March), in which I colour band the population and determine each individual's social status, as well as spring work (April–June), in which I record singing interactions and conduct complementary field and aviary experiments. Analyses from the 2009 field season are ongoing and I plan to collect additional data in 2010.

Field Technician: Leanne Wilson

Collaborators: Laurene Ratcliffe, Cory Toth

Van La- “The vocal behaviour of Common Loons: behavioural and temporal signalling strategies and communication networks” – MSc Thesis

For animals to communicate effectively, a signal must be detected and recognized by a receiver in order to evoke a response. As signals transmit further through the environment, the risk of masking and degradation by changing weather patterns increases substantially. This is especially true in long-distance signals, such as the calls of Common Loons (*Gavia immer*) whose vocalizations travel several kilometres to reach their intended receivers. As a consequence, long-distance signallers may choose to vocalize less during times when abiotic conditions impair long-distance communication or adopt behavioural strategies to transmit their signals further.

My graduate research explores the diel rhythms of Common Loon vocal behaviour and evaluates the effects of weather and body posture on Common Loon signalling strategies. To understand the extent of weather variation on loon vocal behaviour, we used an innovative long distance Acoustic Monitoring System that allows us to passively monitor the natural vocal behaviour of multiple animals across great distances over extended time periods.

In April to May 2009, we deployed an Acoustic Monitoring System that consisted of a linear array of ten simultaneously recording microphones across three freshwater lakes: Lake Opinicon, Lower Rock Lake and Upper Rock Lake. This system allowed us to record Common Loon vocal behaviour across a 10km transect, while simultaneously allowing us to approximate signal transmission distances and vocal activity. We also performed a signal transmission experiment where we broadcast vocalizations from three different positions above the water to determine if body posture affects signal transmission. We successfully recorded over 1000 hours of vocal activity from 16 Common Loon pairs. We thank the Lower Rock Lake Association for their support in this project.

Field Technician: Natalie Bond

Dr. Bob Montgomerie - Department of Biology, Queen's University

“Sexual Selection”

Dr. Sara Calhim – “Testes Asymmetry and Sperm Traits in Centrarchid Fishes” – PostDoc

Combined testes size has been widely used in comparative and within species studies as an index of the intensity of postcopulatory sexual selection: species and/or individuals with relatively larger testes experience higher levels of sperm competition. It is however difficult to obtain accurate testes size estimates, particularly when they are internal and vary seasonally. In addition, left and right testis may differ in size, a common (yet unexplained) pattern in birds.

A recent study on whitefish (Burness et al. 2008) suggested some interesting links between testes asymmetry and sperm motility. It is unknown to what degree testis asymmetry is present in fish, and its potential evolutionary causes and correlates. My aim is to investigate the latter.

In collaboration with Dave Philipp (University of Illinois, USA), Steve Cooke (Carlton University, Canada), and Brian Neff (University of Western Ontario, Canada), I collected and dissected breeding Centrarchid males from Lake Opinicon: smallmouth bass (n= 4), largemouth bass (n= 4), rock bass (n= 5), pumpkinseed sunfish (n= 15) and bluegill sunfish (n= 40). I collected data on testes (size, asymmetry), sperm (morphology, in vitro motility) and for the two sunfish sp., also opercular flap (size, colouration).

Publication:

Burness G, Schulte-Hostedde A, Montgomerie R 2008 Body condition influences sperm energetics in lake whitefish (*Coregonus clupeaformis*). Canadian Journal of Fisheries and Aquatic Sciences 65:615-620

Dr. Chris Moyes – Department of Biology, Queen's University

“Muscle Physiology”

The Moyes lab studies the mechanisms that animals use to modify muscle in response to environmental challenges. This past year, we explored two main questions at QUBS:

First, we studied the mechanisms that fish use to remodel muscle in response to oxygen. Another aspect is the way in which evolution leads to interspecies differences in the hypoxic metabolic properties of fish. The work involved 1 graduate student, **Rhiannon Davies** (cosupervised with Yuxiang Wang), as well as summer SWEP student **Trevor Snider**. We focused on two species of sunfish caught at QUBS and the surround area: pumpkinseed and bluegill. We collect fish on site, record water conditions and process the samples for analysis of proteins, RNA and DNA.

Second, we studied the evolutionary diversity of muscle properties in rodents. We based our collections at QUBS, collecting red squirrels, black squirrels and chipmunk. Animals were trapped, euthanized and muscles collected for subsequent analyses. The work was the main project of one graduate student **Christine Genge**, with the assistance of two other students, **Alex Little** and **Katrinka Kocho**.

Publications:

Davies, R, CD Moyes, Y Wang (2011) Intra- and inter-specific variation in metabolic gene expression in relationship to environmental hypoxia. *Comparative Biochemistry Physiology A Molecular Integrative Physiology* 159: 25-31 ([Abstract](#))

Kocha KM, CE Genge and **CD Moyes** (2011) Origins of interspecies differences in mammalian muscle metabolic enzymes. *Physiological Genomics*, in press ([Abstract](#))

Kit Muma - Species composition and seasonality of fireflies at Q.U.B.S. – Department of Biology, Ithaca College, NY

Are fireflies disappearing? What species are present in the QUBS region? What habitats have the greatest numbers? What is their seasonality? How are they affected by weather and moonlight? How do our firefly numbers compare with other regions in North America? During the summer of 2009 I documented firefly species and numbers in several areas of the Queen's point - at the Operations Centre, the aviary / compost field and in the woods surrounding Earl cottage. I also collected data as part of the "Firefly Watch" citizen science program from the Museum of Science (Boston) <https://www.mos.org/fireflywatch/>

In future seasons I wish to address the following questions: Are numbers fluctuating or stable? Are there certain habitats that should be preserved? What affect does mowing a field have on firefly numbers? Do local activity patches change from night to night? Do older males take more risks in their flight? Is there an adaptive significance to higher flight paths as the night progresses? Do the colour flashes act as a deterrent to aerially-foraging bats?

Dr. Bryan D. Neff - University of Western Ontario, London, Ontario

“Mating systems in fish”

During summer 2009 my research group continued our collaboration with Dr. Rosemary Knapp from the University of Oklahoma in our investigation of parental care in bluegill sunfish (*Lepomis macrochirus*) and endocrinology. This summer a new graduate student, Chandra Rodgers, began work on this endocrinology program by experimentally manipulating testosterone levels in parental males. Chandra then observed parental care behaviours, and assessed changes in hormone and mRNA levels. In addition, Scott Colborne and Marie-Christine Bellemare began an investigation comparing various aspects of the different bluegill sunfish reproductive morphs.

Chandra Rodgers – “Hormone levels and behaviour of male sunfish” - M.Sc. thesis

In many species, the female is the sole parental care-taker of her offspring. The parental behaviours of bluegill sunfish are remarkable in that the male is the sole care-taker for his offspring, whereas the female will drop her eggs in a male's nest and move along. These parental males put a large portion of their energy into intense care for their offspring. Testosterone levels may have an affect on the parental behaviours of male bluegill sunfish in that it may change levels of transcription to influence the probability of displaying certain parental behaviours more frequently. This summer, we tested to see if implanting different levels of testosterone in the parental male bluegill changed their subsequent parental behaviour. Following the implantations, parental behaviours related to nest care and predator defense were observed. We aim to determine if there is an ideal level of testosterone in males that will influence their behaviours to become ideal parents. Blood samples from these fish will be analysed using hormone assays to determine the circulating levels of testosterone before and after the implants. Additionally, we will be examining mRNA levels of the fish to see how testosterone may alter the transcription of DNA.

Scott Colborne – Reproductive tactics and body form and diet in sunfish - Ph.D. thesis

Many studies have focused on the alternative reproductive tactics used by male bluegill sunfish. Most males develop into a 'parental' form; maturing at 7 years of age when they build nests and provide parental care for their offspring. Some males will instead adopt a 'cuckolder' strategy to obtain mating opportunities, maturing at 2 years of age. 'Cuckolders' first act as 'sneakers', darting into nests and releasing sperm before 'parental' males drive them away. By 4 years of age 'cuckolders' will have grown in size and change their strategy to 'satellite' males, mimicking the appearance of females so 'parental' males allow them to participate in spawning. These different strategies lead to a population of reproductive males that are quite diverse in their physical characteristics which may influence other aspects of life including shape, diet, and swim performance. During the summer of 2009 we sampled bluegills of each male reproductive form (parental, sneaker, and satellite) and females to begin an examination of behaviour, swimming ability, body form and diet. By examining these factors we hope to gather a greater understanding of how reproductive tactic may influence other aspects of life not directly related to spawning.

Assistant: Marie Christine Bellemare - Summer research student, Université du Québec à Montréal

Dr. David P. Philipp - Illinois Natural History Survey at the University of Illinois

“Long-Term Monitoring of Largemouth Bass and Smallmouth Bass Reproductive Success”

Documenting trends and long-term changes in populations is essential for understanding many natural phenomena or the potential significance of human activities. For almost two decades, we have run a long-term monitoring program for largemouth and smallmouth bass, recording the total reproductive activity at four island sites within Lake Opinicon. These habitats have been surveyed annually during the spawning season by visual swims using a mask and snorkel. Data collected includes the date of each individual spawn, location of the nest, depth, assessment of mating success (number of eggs laid), size of parental male, and duration of parental care for each male, as well as the occurrence of hookwounds from angling. Visual swims to determine number of age-1 and age-2 largemouth and smallmouth bass are also done to assess year class strength. By determining the success or failure of each male in raising a brood, we can calculate total fry production for each site each year, as well as determine the subsequent year class strength. Due to the length of this program, we are currently assessing how possible climatic changes could be affecting reproductive activities in bass.

Project Team Members: David Philipp, Brandon Barthel, Jeff Stein, Niels Carlson, Julie Claussen, Liane Nowell, Andrew Weatherhead, Mickey Philipp

Brandon Barthel – “ Reproductive Ecology and Seasonal Movement of Smallmouth Bass in the Mississippi River Watershed” - Phd Thesis Department of Natural Resources and Environmental Sciences, University of Illinois at Urbana-Champaign

Smallmouth bass are found in both rivers and lakes in southern Ontario. Our research team has been studying a portion of the Mississippi River that flows into Millers Lake to study the reproductive ecology of smallmouth bass that inhabit this connected river-lake environment. Our studies focus on monitoring the reproductive success of individual nesting males, many which have been previously pit-tagged. The data gained from these ongoing projects continue to provide insight into recruitment mechanisms and nest-site fidelity, improving our ability to manage and conserve smallmouth bass populations. A three-year telemetry project resulted in detailed assessments of pre and post spawn movements and provided insight into habitat use and seasonal movements. It has also led to the hypothesis that multiple life history strategies may be present among the fish of the system. This comprehensive project will continue to improve the understanding of the ecology of smallmouth bass.

Project Team Members: David Philipp, Brandon Barthel, Jeff Stein, Niels Carlson, Julie Claussen, Andrew Weatherhead, Mickey Philipp, Liane Nowell

“Growth, Survival and Movement of Northern Pike”

The Northern Pike, *Esox lucius*, is found in freshwater throughout the northern hemisphere and are slender predatory fish, popular with anglers. Despite their popularity as a sportfish, not many long-term studies have been conducted to determine basic population level size and growth data. We have conducted a continuous mark and recapture effort on the northern pike population in both Lindsay and Poole Lakes over the past ten years. We are capturing these pike repeatedly using hook-and-line angling techniques. Once captured, the fish are measured, sexed, given a pit tag, and released. These data are providing measurements of growth and survival, as well as territoriality among these fish. Data analysis is indicating a high level of within and among year fidelity to small summer home ranges by almost all of the pike in this population, with more movement observed between seasons.

Project Team Members: David Philipp, Jeff Stein, Niels Carlson, Mickey Philipp, Liane Nowell

“Assessment of Spring Management Scenarios for Bass Recruitment”

Sportfish species with long-term parental care, such as bass, are especially vulnerable to angling during their reproductive season. To determine how various management regulations on nesting bass effect population level reproductive success and recruitment, six lakes within the Kenauk reserve in Quebec were given different management scenarios. Each lake was then monitored during the entire spawning season. Using a mask and snorkel to locate nesting bass, we recorded nest location, date of each individual spawn, mating success, size of nesting male, and duration of parental care for each male, as well as catch-and-release angling activity for each lake. Visual swims to determine number of Age-1 and Age-2 largemouth and smallmouth bass were also conducted to assess year class strength. After a few years, we will then determine how each management strategy affects reproductive success and recruitment.

Project Team Members: David Philipp, Cory Suski, Jeff Stein, Steve Cooke, Niels Carlson, Liane Nowell, Andrew Weatherhead, Mickey Philipp, Julie Claussen

Publications:

- 2009 Siepker, MJ, SJ Cooke, DH Wahl, and DP Philipp. 2009. Individual Reproductive Success of Largemouth Bass and Smallmouth Bass Subjected to Different Components of Competitive Angling Events. Transactions of the American Fisheries Society. Volume 138, Issue, pp. 818-825
- 2009 Hasler, C.T., C.D. Suski, K.C. Hanson, S.J. Cooke, D.P. Philipp, and B.L. Tufts. In Press. The effect of temperature on laboratory swimming performance and natural activity levels of adult largemouth bass. Physiological and Biochemical Zoology 00:000-000.
- 2009 Redpath, T.D., S.J. Cooke, R. Arlinghaus, P. Couture, D.H. Wahl and D.P. Philipp. In Press. Metabolic consequences of artificial selection for vulnerability to angling in a teleost fish: Insights from physiology and biochemistry. Journal of Experimental Biology 00:000-000.
- 2009 Redpath, T.D., S.J. Cooke, C.D. Suski, R. Arlinghaus, D.H. Wahl and D.P. Philipp. In Press. Response of life history traits and energetic status to artificial selection for vulnerability to angling in a teleost fish. Ecological Applications 00:000-000.
- 2009 Gingerich, A.J., D.P. Philipp, D.H. Wahl, and C.D. Suski. In Press. The effect of body size on disturbance and recovery in largemouth bass. Physiological and Biochemical Zoology 00:000-000.

Dr. Heather Proctor - Department of Biological Sciences, University of Alberta

“Molecular phylogeny of the water mite taxa Unionicolidae and *Arrenurus* (Arrenuridae)”

The main goal of this visit was to re-collect species that were included in my Ph.D. work on the evolution of mating behaviour in the Unionicolidae (Proctor, H.C. 1992. Animal Behaviour 44: 745-752), with the goal of rigorously testing the previous hypothesis, based on a phylogeny derived from morphology and behaviour, using a molecular approach. A secondary goal was to collect *Arrenurus* species that displayed a range of sexually dimorphic characters in order to eventually examine the origin of intermittent sperm transfer in this genus. I re-collected approximately 50% of the species required for the first goal, and got a good diversity (about 15 spp.) of *Arrenurus* as well. A return visit to QUBS will be required to complete this collection - most likely in late spring or early summer 2010.

Dr. Raleigh J. Robertson – Department of Biology, Queen’s University

“Behavioural Ecology and Conservation Biology of Birds”

As I moved one step closer to full retirement by downscaling to a quarter-time appointment at Queen’s, my research involvement at QUBS was quite limited during 2009.

Warbler Project – I contributed peripherally to **Mark Conboy's** study of wood-warbler habitat and territory relations in relation to phylogeny. This work focuses on the *Dendroica* warblers, including the Cerulean Warbler, which has been the subject of past studies by my graduate students. In the course of this study, Mark is providing further insights into the habitat relations of both the Cerulean as well as the Golden-winged Warbler. Mark is an M.Sc. student supervised by **Paul Martin**.

Tree Swallow Project - I continued to collaborate with **Adjunct Assistant Professor, Dr. Francis Bonier**. In 2009, her B.Sc. honours student, **Dana Drumm**, worked at QUBS on the breeding populations at QUBS, and for her thesis she is using our long-term data set to answer questions about a possible population decline of this once very abundant aerial insectivore.

Publications :

- Fraser, K. C., T. Kurt Kyser, R. J. ROBERTSON and L. M. Ratcliffe 2008. Seasonal Patterns in Hydrogen Isotopes of Claws from Breeding Wood-Warblers (Parulidae): Utility for Estimating Migratory Origins. *Avian Conservation and Ecology - Écologie et conservation des oiseaux* 3 (1): 2. [online] URL: <http://www.ace-eco.org/vol3/iss1/art2/>
- Buehler, D.A., J.J. Giocomo, J. Jones, P.B. Hamel, C.M. Rogers, T.A. Beachy, D.W. Varble, C.P. Nicholson, K.L. Roth, J. Barg, R.J. ROBERTSON, J.R. Robb and K. Islam. 2008. Cerulean Warbler reproduction, survival and models of population decline. *Journal of Wildlife Management* 72(3): 646-653.
- Jones, J. D.R. Norris, M. K. Girvan, J.J. Barg, T.K. Kyser and R.J. ROBERTSON. 2008. Migratory connectivity and rate of population decline in a vulnerable songbird. *Condor* 110(3): 538-544.
- Neville, K.J., R. Vallender and R.J. Robertson . 2008. Nestling sex ratio of golden-winged warblers (*Vermivora chrysoptera*) in an introgressed population. *Journal of Avian Biology* 39: 599-604.
- Delmore, K.E., O. Kleven, T. Laskemoen, S.A. Crowe, J.T. Lifjeld and R. J. ROBERTSON. 2008. Sex allocation and parental quality in tree swallows. *Behavioral Ecology* 19: 1243-1249.
- King, L.E., V.J. Emery, R.J. Robertson, R. Vallender and P.R. Martin. 2009. Population densities of Golden-winged Warbler, Blue-winged Warbler and their hybrids, in eastern Ontario. *Ontario Birds* 27: 2 – 22.
- Bonier, F., P.R. Martin, I.T. Moore and R.J. ROBERTSON. 2009. The relationship between fitness and baseline glucocorticoids in a passerine bird. *General and Comparative Endocrinology* 163 (2009) 208–213.
- Crowe, S.A., O. Kleven, J.J. Nocera, K.E. Delmore, T. Laskemoen, J.T. Lifjeld, and R.J. ROBERTSON. 2009. Paternity assurance through frequent copulations in a wild passerine with intense sperm competition. *Animal Behaviour* 77: 183-187.
- Kleven, O, F. Fossoy, T. Laskemoen, R.J. ROBERTSON, G. Rudolfson and J.T. Lifjeld. 2009. Comparative evidence for the evolution of sperm swimming speed by sperm competition and female sperm storage duration in passerine birds. *Evolution* 63 (9): 2466 – 2473.
- Harper, S. L., R. Vallender and R.J. Robertson. In press. Male song variation and female mate choice in Golden-winged Warblers. *Condor* (accepted 7 Nov 2009 – Ms ID COND-08-0093.R1).

Dr. Risa Sargent - Department of Biology, University of Ottawa, Ottawa

“Evolutionary ecology of flowering plants and pollinators”

Research in our lab focuses on the evolutionary ecology of flowering plants and their pollinators. We address questions concerning the influence of pollinators on floral trait evolution and plant community assembly.

Elizabeth Da Silva – “The impact of the invasive purple loosestrife (*Lythrum salicaria*) on reproduction of a co-flowering native, swamp loosestrife (*Decodon verticillatus*)” – MSc. Thesis

The introduction of a novel plant species in a community can result in a variety of new ecological interactions. These range from facilitative, where mutually beneficial interactions can aid in the establishment of the introduced species, to competitive, in which invasive introduced species vie for limited resources with natives,

possibly at the expense of native plants. Our research at QUBS explores the potential for the highly attractive flowering plant, *Lythrum salicaria* (Lythraceae), to alter pollinator movement and subsequently, reproduction in *Decodon verticillatus*, a co-flowering native plant of the same family. We chose to use pollen limitation to investigate the potential for such an impact of *L. salicaria* on *D. verticillatus*.

During the spring and summer of 2009, we identified 8 *D. verticillatus* sites around Lake Opinicon and Indian Lake that had or had not been invaded by *L. salicaria*. Over the course of the flowering period in late summer, 5 of these sites were monitored for flowering density and pollinator diversity. Pollen quality and quantity on *D. verticillatus* stigmas was quantified and pollen limitation was tested by supplementing all flowers on 15 of 30 treatment branches in each population. To compliment this research, NSERC Undergraduate Summer Research Assistant Vashti King monitored pollinator movement in sub-plots at each population. Data from this research is currently being analyzed.

Assistants: Vashti King, Spencer Monckton

Dr. Bruce P. Smith - Biology Dept., Ithaca College, Ithaca, NY 14850.

“Sex Ratio Skew in Water Mites”

I spent a short (5 week) field season in Summer 2009, primarily spent collecting and raising family lines of *Arrenurus manubriator* water mites. My previous research had documented that there are profound sex ratio skews in this species, with individual females producing anywhere from a male bias of 50:1 to a female bias of 50:1. There appears to be a continuous range of variability between these extremes, and the bias seen in clutches of progeny is apparently consistent throughout the life of the maternal parent. The cause of this sex ratio bias remains unclear: screens for *Wolbachia* or related rickettsial sex-ratio distorting endosymbionts were negative.

Progeny from this summer's rearing efforts are now being used for selective breeding experiments. My previous attempt indicated that the sex ratio bias is inherited only through the maternal line, current research is to confirm this pattern and increase the sample size. Maternal inheritance is consistent with vertical transmission of endosymbionts via egg cytoplasm (e.g., *Wolbachia*, *Orientia*, and microsporidians).

For a second, related study, I raised engorged larval mites of three species from three different host species (*Arrenurus reflexus* from *Leucorrhinia intacta*, *A. fissicornis* from *Libellula luctuosa*, an unnamed *Arrenurus* species near *reflexus* from *Leucorrhinia frigida*). Mites were kept separate for each individual host, and the sex ratio of resultant adults were recorded. In a previous season, I discovered that the sex ratio shifts throughout the season, starting as 1:1, then shifting to profoundly female-biased (ca. 50:1) for the end of the season. Given that newly hatched larval mites of species with parasitic associations attach to hosts only when the host transforms into an adult, and that newly hatched larvae can only survive without a host for about one week, all larvae on a given host individual must have hatched within a week of each other. Larval mites spend 7-10 days on a host, so mites sampled from a host represent a relatively narrow window in time.

The resultant adult mites from the second-mentioned study will be used in an unrelated study later in the year, testing for cross-reactivity in female-emitted sex pheromones, and possible prezygotic isolating barriers. In past studies conducted in my research lab, it has been evident that in general, sex pheromones are not species-specific, but that other premating isolation mechanisms may be employed in close-range interactions.

Dr. Cory Suski - Department of Natural Resources and Environmental Sciences, University of Illinois, Champaign, IL

“Biotic and abiotic influences on reproduction in fish”

Annual year class strength for fish is highly variable and can be dictated by many factors. Currently, variation in the survival of embryo & egg stages is believed to be one of the most important drivers of year class strength in fish. Largemouth bass and smallmouth bass are excellent model species for studies regarding factors influencing year class strength in fish due to their protracted parental care period, accessible nests and predictable spawning behaviours. In largemouth bass and smallmouth bass, the mechanism dictating survival of eggs embryos

are not well understood and could be related to biotic and abiotic factors such as timing of reproduction, temperature fluctuations, nutritional status of embryos, and general embryo 'quality'. Our research in this area seeks to quantify factors that define year class strength and recruitment for bass, with efforts focusing mainly on the egg/larvae/embryo stages.

In 2009, our research built upon previous studies within our group regarding the role of stochastic temperature fluctuations on year class strength in largemouth and smallmouth bass. Using micro-respirometry, we quantified the consequences of temperature fluctuations of three different magnitudes on the energetic cost and oxygen consumption, of eggs, egg sac fry and pigmented larvae of smallmouth bass and largemouth bass. Results will not only improve our understanding of larval fish physiology, but also will enhance our understanding of forces that dictate recruitment and year class strength for fishes.

Assistants: Zac Blevins, Lianne Nowell

Dr. Hans Van Gossum – Department of Biology, University of Antwerp, Belgium

“Female Morphs in Dragonflies”

Nehalennia irene is a small damselfly which inhabits marshy or boggy waters and is common throughout most of Canada and the northern parts of the United States. This species shows one male and two female morphs. Andromorph females resemble males in body coloration and abdominal pattern, while gynomorphs are differently coloured. The frequency of both female morphs can differ largely between populations, with gynomorphs mainly present in Ontario (QUBS) and a reverse situation in British Columbia. Both female morphs are thought to be maintained by sexual conflict, with males harassing females to such extent that it may ultimately affect fitness. However, the amount of harassment that a female morph receives may depend on the relative frequency of the morphs in a population. We have been working on quantifying harassment rate and subsequent fitness consequences of both female morphs in populations with varying morph frequencies.

In the summer of 2009, fieldwork was done in order to extend several datasets for which we yet had data from previous years. First, we repeated the work started in 2008 regarding the number of mated females per morph in free living populations (see above). Second, individuals were collected in three populations near QUBS, to determine morphometrics, condition and fecundity as part of a three year dataset (2007-2009), which is still in progress.

Publications:

Iserbyt, A., Bots, J., Ting, J.J., Jvostov, F.P., Forbes, M.R., Sherratt, T.N. & Van Gossum, H. 2009. Multi-annual variation in female morph frequencies of the polymorphic damselfly, *Nehalennia irene*, at continental and regional scales. *Animal Biology* 59, 313-326.

Ting, J.J., Bots, J., Jvostov, F.P., Van Gossum, H. & Sherratt, T.N. 2009. Effects of extreme variation in female morph frequencies on the mating behaviour of male damselflies. *Behavioral Ecology and Sociobiology*, in press.

Dr. Patrick J. Weatherhead - Program in Ecology, Evolution and Conservation Biology,
University of Illinois

“Long-term studies of snakes and birds”

The long-term study of black ratsnakes continued in 2009. This study is being done collaboratively with Dr. Gabriel Blouin-Demers, who provides details of the study in his entry in this report. Analysis of data from previous studies of red-winged blackbirds is ongoing.

Publications:

- Blouin-Demers, G., L.P.G. Bjorgan and P.J. Weatherhead. 2007. Changes in habitat use and movement patterns with body size in black ratsnakes (*Elaphe obsoleta*). *Herpetologica* 63: 421-429.
- Blouin-Demers, G. and P.J. Weatherhead. 2007. Allocation of offspring size and sex by female black ratsnakes. *Oikos* 10: 1759-1767.
- Blouin-Demers, G. and P.J. Weatherhead. 2008. Habitat use is linked to components of fitness through the temperature dependence of performance in ratsnakes (*Elaphe obsoleta*). *Israeli Journal of Ecology and Evolution* 54: 361-372.
- Cooke, S.J., P.J. Weatherhead, D.H. Wahl and D.P. Philipp. 2008. Parental care in response to natural variation in nest predation pressure in six sunfish (Centrarchidae: Teleostei) species. *Ecology of Freshwater Fish* 17: 628-638.
- Howes B.J., J.W. Brown, H.L. Gibbs, T.B. Herman, S.W. Mockford, K.A. Prior and P.J. Weatherhead. 2009. Directional gene flow patterns in disjunct populations of the black ratsnake (*Pantheropsis obsoletus*) and the Blanding's turtle (*Emydoidea blandingii*). *Conservation Genetics* 10: 407-417.
- Row, J.R., G. Blouin-Demers and P.J. Weatherhead. 2007. Demographic effects of road mortality in black ratsnakes (*Elaphe obsoleta*). *Biological Conservation* 137: 117-124.
- Weatherhead, P.J. 2009. Multi-year seasonal sex-allocation patterns in red-winged blackbirds. *Auk* 126: 181-185.
- Weatherhead, P.J. and T. Madsen. 2009. Linking behavioral ecology to conservation objectives. Pages 149-171. In: *Snakes: Ecology and Conservation* (S.J. Mullin and R.A. Seigel, eds.), Cornell University Press.
- Weatherhead, P.J., K.E. Muma, J.D. Maddox, J.M. Knox and K.W. Dufour. 2007. Morphology vs. molecules: sexing red-winged blackbird nestlings. *Journal of Field Ornithology* 78: 441-448.

Dr. D. Dudley Williams - Ecology and Evolutionary Biology, University of Toronto

“Food Webs in Aquatic Systems”

Tiffany Schriever - “Food web ecology of temporary ponds”- PhD thesis

During the summer of 2009, we continued the research on food web ecology of ponds with the addition of two ponds. We also implemented advanced GPS and GIS mapping of each pond on a monthly basis. Many, if not all, of the temporary ponds are not mapped and are not on the QUBS basemaps because of their transient nature and small size. Therefore, we have added locality information on important amphibian breeding site locations.

Acknowledgements: NSERC award to D. Dudley Williams and a graduate student research award from the Center for Global Change Science granted to Tiffany Schriever. Fiona Munro for assistance with GIS/GPS work.

Dr. Jayne E. Yack - Department of Biology, Carleton University

“Acoustic Communication in Insects”

Research in the Yack lab currently focuses on the identification and characterization of novel acoustic communication systems in invertebrates. In 2009, two main projects were conducted at QUBS: sound production in Bombycoidea caterpillars, and hearing in butterflies. In addition, we collected specimens for a continuing project on vibratory communication in hooktip moth caterpillars.

Veronica Bura - "The Function and Diversity of Sound Production in Bombycoidea Caterpillars" - M.Sc. Thesis

Veronica's M.Sc. project focuses on the phenomenon of sound production in caterpillars. Although caterpillars are generally thought to lack the ability to produce sounds, we have now discovered that airborne sound production is widespread in the large group Bombycoidea, which includes the silk- and hawk-moths. To date, Veronica has discovered several different sound producing mechanisms including clicking, stridulation, whistling, and evidence that sound production has evolved multiple times in the Bombycoidea. More than a dozen sound producing species were collected at QUBS in 2009, with the help of field assistant Jenn Mongrain. Sounds are thought to function in defense against avian predators. We are working in collaboration with Dr. Paul Martin to test hypotheses on the effects of these sounds on local bird species.

Assistant: Jenn Mongrain

Jean Paul Fournier "What do Butterflies Hear?" - M.Sc. Thesis

Until recently, butterflies were thought to lack a sense of hearing. However, research over the past several years from our laboratory has revealed that many species belonging to the large cosmopolitan family Nymphalidae (brush footed butterflies) possess well developed tympanal hearing organs at the base of their forewings. At present, we do not know the function of hearing in these butterflies. Jean Paul Fournier is testing the hypothesis that butterflies are hearing the flight sounds, or contact calls of predatory birds. Jean Paul is working in collaboration with Drs. Paul Martin and Frances Bonier to characterize the sounds that birds make when feeding on insects. These sounds will be played back to neurophysiological recordings of butterflies to determine if butterflies are capable of hearing these sounds.

Assistant: Jenn Mongrain

Jayne Yack, Jaclyn Bowen, Sarah Bond, Shannon Mahony: "Vibratory Communication in Hook tip moth Caterpillars"

During the past 8 years we have been studying vibratory communication signals in hook tip moths (Drepanoidea). These caterpillars use vibrations to defend silken leaf shelters, and to communicate with nest mates using complex vibratory signals. We are studying several aspects of the communication system, including the function of signaling in social groups, sensory capabilities for detecting and processing vibrations, factors affecting motivation to signal, and the evolutionary origins of vibratory communication. Although experiments are conducted in our laboratory at Carleton University, wild gravid female specimens are collected at QUBS each year to maintain our colony.

Assistant: Jenn Mongrain

Publications :

Scott JL, Bond SM, Yack JE (In press) Variations on a theme: Vibrational signaling in the rose hook-tip caterpillar, *Oreta rosea* (Drepanoidea: Drepanidae). Journal of Insect Science

Rashed A, Khan MI, Dawson JW, Yack JE, Sherratt TN (2009) Do hoverflies (Diptera: Syrphidae) sound like the Hymenoptera they morphologically resemble? Behavioral Ecology 20(2):396-402

Bowen JL, Mahony SJ, Mason AC, Yack JE (2008) Vibration mediated territoriality in the warty birch caterpillar *Drepana bilineata* (Drepanoidea: Drepanidae). Physiological Entomology 33:238-250

Summary of Conference, Meeting and Field Trip Use of QUBS in 2009

Organizer	Function	Numbers	Duration
Drs. Lamoureux and Lafreniere (Queen's - Geography)	Geography 312 Winter Field Trip	20	Feb-11
Kathy Marrocco (Amherstview Public School)	Counselling and Skills Development Class Winter Field Trip	13	Feb 25 - 27
Alex Banks (Queen's)	Science Quest Workshop and team-Building	13	Mar 14 - 15
Dr. Gabriel Blouin-Demers (Ottawa - Biology)	Animal Behaviour Field Trip	50	Apr 4 - 5
Kathy Hoover (Queen's - Geography)	Departmental Retreat	22	Apr-21
Tim Demmons (Opengo High School)	OSPREY - Field Trip	22	Apr 22 - 24
Capt. Ray Throop (Canada Coast Guard)	Advanced Boating Course MEDA3	18	May 8
Dale Kristensen (Queen's - Biology)	Life Down Under Workshop	26	May 16
Jim Ludden (College of DuPage, Illinois)	General Ecology Field Course	12	May 18 - 23
Melanie McEwen (Queen's Alumni Relations)	Queen's Mini-U Field Trip	48	May 23
Floyd Connor (Queen's Biological Station)	Keast Fest Celebrating the life of Dr. J.A, Keast	105	June 13

Summary Cont'd

Bob Crandall (Queen's - RAQ)	Retirees Association of Queen's Field Trip and Picnic	28	July 22
Melanie Fortner (Queen's - Biology)	Second Annual Community Dinner Mike Runtz - Featured Speaker	59	Aug 29
Diane Lawrence (Queen's - Education)	Environmental Education Field Trip and Workshops	40	Sept 12 - 13
Ted Thomas (N Park Collegiate, Brantford)	North Park Collegiate	29	Sept 16 - 18
Brenda Schamehorn (Queen's - Biology)	Field Trip and Ecology Course Bio 302 - General Ecology Field Trip Weekend	63	Sept 26 - 27
Richard Aaron (Natureteacher.org)	Fabulous Fall Fungi Workshop	17	Sept 29 - Oct 2
Brenda Schamehorn (Queen's - Biology)	Bio 302 - General Ecology Field Trip Weekend	75	Oct 3 - 4
Dr. Brian Cumming (Queen's - Biology)	Bio 335 - Limnology Field Trips	38	Sept 21
Dr. Doug Archibald (Queen's - Geology)	Geol 221/211 - Geological Field Methods Field Trip	25	Oct 7
Dr. Doug Archibald (Queen's - Geology)	Geol 221/211 - Geological Field Methods Field Trip	25	Oct 8
Dr. Scott Lamoureaux (Queen's - Geography)	SEDIBUD Workshop (Sediment Budgets in cold environments)	15	Oct 13 - 16
Sue MacLatchie (CLAHS)	Chaffey's Lock and Heritage Society Board Meeting and Winter Social	16	Dec 16

Summer Seminar Series 2009

Seminars held 7:00pm in Operations Centre Conference Room

Wednesday, May 6

Dr. Patrick Weatherhead (University of Illinois at Champaign-Urbana)

“Linking snake behaviour to avian nest predation”

Wednesday, May 13

Dr. Steve Loughheed (Department of Biology, Queen’s University)

“Putting QUBS on the map: Enhancing electronic resources and research opportunities”

Wednesday, May 20

Dr. Frances Bonier (Queen’s University)

“Field endocrine studies of tree swallows: What do hormone levels tell us about individual fitness?”

Wednesday, May 27

Dr. Vicki Friesen (Queen’s University)

“A bird in the Bush Administration: marbled murrelet conservation genetics?”

Wednesday, June 3

Dr. Sara Calhim (Queen’s University)

“My what a piece of work are testes”

Wednesday, June 10

Jeremy Holden (Ontario Federation of Anglers and Hunters)

“The role of NGO biologists in fisheries management”

Wednesday, July 8

Dr. Bruce Tufts (Queen’s)

“A physiologist’s perspective of the Amazon”

Wednesday, July 15

Michael Runtz (Carleton)

“Killers, lovers, con artists and sex surrogates – the lives of local insects”

Wednesday, July 22

No Seminar

Wednesday, July 29

Kyle Harris (MNR Kingston)

“The Bear Wise Program” (and other large animal concerns)”

Wednesday, Aug 5

Steve Kerr (OMNR Peterborough)

“A look down under: Fish and Fisheries Issues”

Seminars 2009 Cont'd

Amanda Smith (OMNR Peterborough)
“The Ministry of Natural Resources Internship Program”

Tuesday, Aug 11

Dr. Heather Proctor (U Alberta)
“Birds as habitat: the ecology and diversity of avian mites (Arachnida:Acari)”

Wednesday, Aug 19

Dave Coppelstone (OFAH)
“Invasive Species”

Wednesday Aug 26

Simon Lunn
“Biodiversity of the Rideau”



Documentation of Research Use of QUBS in 2009 – User-Days

	PI	Post- Doc	Grad Stud	Hons Stud	Asst	Total
Queen's Researchers						
Aarssen	15			120	60	195
Arnott						
Bonier	29			61	61	151
Campbell						
Cumming	2				3	5
Eckert	3		61		60	124
Grogan	23	3			8	34
Lougheed	10			11	17	38
Martin	42		162	31	94	329
Montgomerie	3	56				59
Moyes	18		67		36	121
Nelson			4		4	8
Ratcliffe	5		220	125	153	503
Robertson	10					10
Tufts	56		151		212	419
Wang						
				Queen's	Subtotal	1996
Non-Q Researchers						
Arlinghaus			11			11
Blouin-Demers	19	57			49	125
Cooke	46		510		175	731
Dawson	2					2
Forbes	3	5	50		30	88
Fullard	49	2	278		107	436
Godin	2		49		49	100
Knapp	11					11
MacDougall-Shackleton	15		180	51	48	294
Mennill		159	41		192	392
Neff	22		75		2	99
Philipp	82		113		179	374
Proctor	7					7
Sargent			41		72	113
Sherratt			16			16
Smith	35				35	70
Suski	45		34			79
Turgeon			2		2	4
VanGossum		16	8			24
Weatherhead	21				15	36
Williams			133		3	136
Windmill			42			42
Wolfe/Taylor	3	3			3	9
Yack					86	86
				Non- Queen's	Subtotal	3285
				RESEARCH	TOTAL	5281

Documentation of Use of QUBS in 2009 – User-Days

	Principal Investigator	Post-Doc	Graduate Student	Honours Student	Assistant	Total
Total Research User-Days	578	301	2248	399	1755	5281
% Queen's	37	19	30	87	40	38
% Non-Queen's	53	81	70	13	60	62
User-Days in Teaching Activities						2003
Conference, Meeting and Field Trip Use						461
Outreach Programs						977
SWEP Program						112
Other*						1197
Grand Total User-Days**						10031

* QUBS Staff, their families and visitors are not included

** up 2.1 % from 2008

Fee Schedule for 2010
University Research and Teaching Rates

Board Charges - Meals only

\$680/month/person	-no obligation for chores
\$475/month/person	-includes obligation for chores on a rotating schedule

Accommodation Charges - Housing only - no linen service

\$52.50/month/person	-dormitory (White House or Curran Cottage)
\$105/month	-small cabin (Cabins 1, 4, 5, 6, 7, 11 and shaker)
\$210/ month	-medium cabin (Cabins 2, 3, 8, 9, 10, 13, 14)
\$282/month	-large cabin (Cabins 12, 15)
\$335/month	-White House Apartment
\$462/month	-Cottage (Keast, Earl or Maplewood)
\$512.50/month	-Sumac or Cedar

Room and Board Rates for Field Courses - no linen service

\$370/person	-weekly R&B for OUPFB field courses
\$405/person	-weekly R&B for other field courses - incl. facilities use fee

Room and Board Rates for Short-Term Users and Guests- no linen service

\$47.15/day/person	-24 hr. room and board
\$7.00	-breakfast or lunch only
\$14.00	-dinner only
\$23.00	-overnight accommodation

Bench Fees

Basic* 1 (Queen's Biology researchers)

\$1.36/day	principal investigator/graduate student/lab coordinator
\$0.68/day	assistant

Special Requirements 1 (MFA co-applicants/Queen's Biology)**

\$3.40/day	principal investigator/graduate student/lab coordinator
\$1.36/day	assistant

Basic* 2 (non-Biology Queen's researchers)

\$3.40/day	principal investigator/graduate student/lab coordinator
\$1.36/day	assistant

Special Requirements 2 (non-MFA Queen's researchers)**

\$6.80/day	principal investigator/graduate student/lab coordinator
\$3.40/day	assistant

Basic* 3 (non-Queen's researchers)

\$6.80/day	principal investigator/graduate student/lab coordinator
\$3.40/day	assistant

Special Requirements 3 (non-MFA non-Queen's researchers)**

\$13.60/day	principal investigator/graduate student/lab coordinator
\$6.80/day	assistant

*Basic - desk/lab bench space only - electricity and/or water

**Special Requirements - tanks, pumps, heating, cooling, air, disposables, extra space

Fee Schedule for 2010 (continued)

NOTE - If sufficient funds are not available, bench fees may be waived or reduced upon written application to the Director.

Electronic Equipment Charges

Local Area Network Connection /Internet \$13.50 per person per month

GPS/GIS Equipment

Charges for maintenance of equipment and systems will be charged back to users based on intensity of use

Boat Rental

\$390/month, \$165/week - includes maintenance from normal use - gas and oil not included
\$87.50/day - includes gas and oil for one day rental

NOTE - Fees for use of pontoon boats are negotiated directly with the Manager or Director

**All QUBS boat users will require Operator Proficiency cards to rent a boat
MEDA3 Training and certification required to operate pontoon boats**

Conference and Group Rates

\$7.02/person/day	facility day use fee - no meals
\$70.20/person/day	24 hr R&B and day use - summer season (April 30 - September 10)
\$18.00/person/day	linen service (must be pre-arranged for groups)

Rates for groups outside of summer season and for special requirements are negotiated directly with the Manager or Director

Rates are based on provision of basic services (dining hall meals, conference room use, dormitory style accommodation) - additional requirements will increase rates

50% booking deposit required (non-refundable if cancellation made less than two weeks prior to event)

Provincial Sales Tax

P.S.T. is applicable to non-Queen's users for oil used in boats, photocopies and Fax .

Goods and Services Tax

G.S.T. is applicable to non-Queen's users for charges for boat rental, photocopies, direct sales (e.g. equipment) and all charges for room and board from casual users.

QUBS Management reserves the right to allocate space to maximize accessibility to all users of the facility. This may mean sharing space at times of intense use.