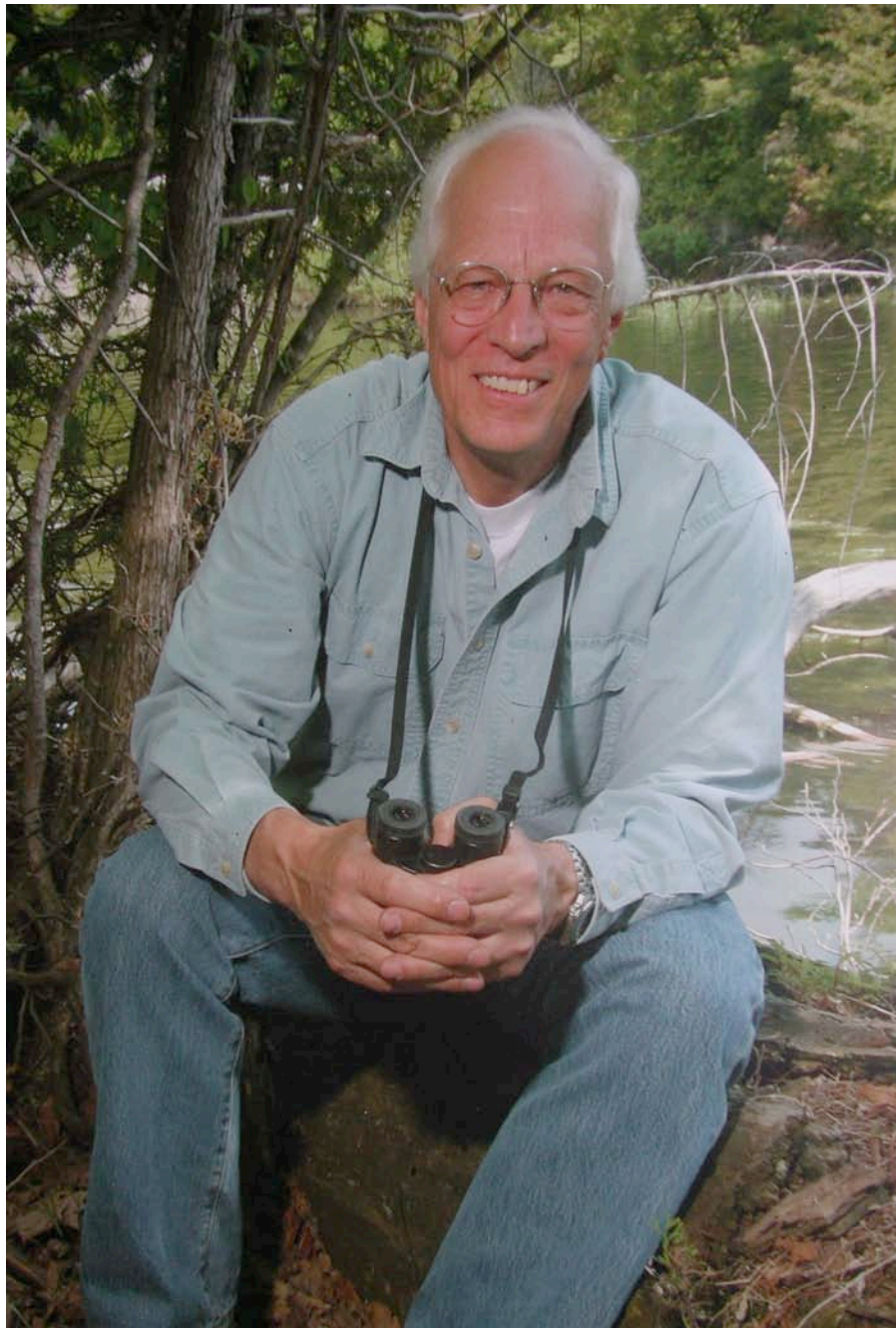


Queen's University Biological Station Annual Report and Newsletter 2005



Dr. Raleigh Robertson - Director 1972-2005 (Bernard Clark Photo)

Director: Bruce Tufts

Manager: Frank Phelan

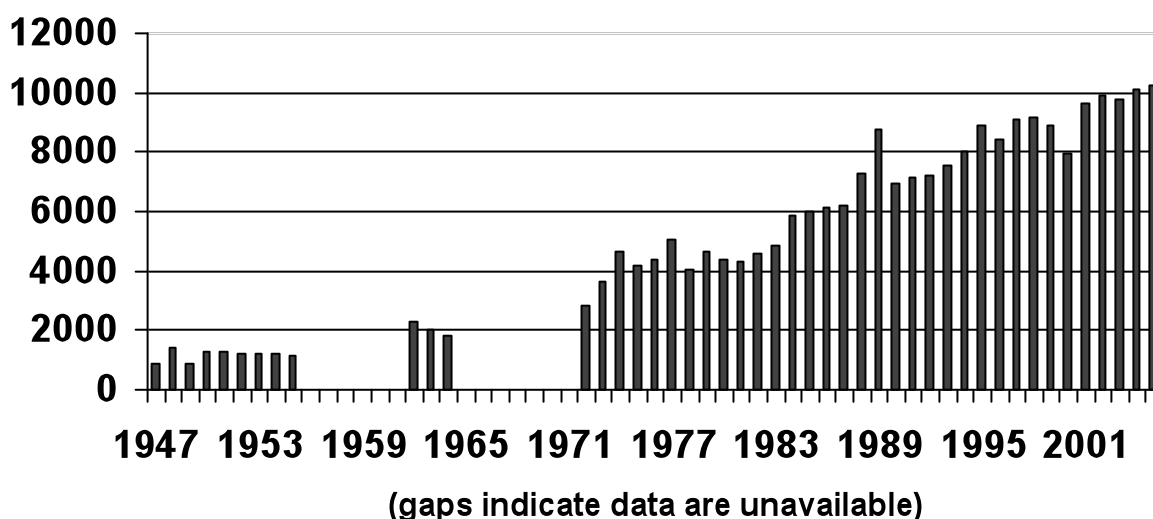
Assistant Manager: Floyd Connor

Introduction

In 2005, the level of use was the highest experienced in the 59 years of operation of QUBS. In 2005, user-days totaled 10,219 (user-day data are displayed in tabular form on pp. 66 and 67). Use was up by 1.1% over 2004. It was a very busy year and a productive one. It will also be remembered as a year of change...

On average, 47 researchers (professors, graduate students, honours students and assistants) were in residence through the summer. Abstracts of 2005 research projects and documentation of the personnel involved are to be found on pages 28 through 60.

User-Days at QUBS



In teaching activities, QUBS hosted 7 modules (11 weeks worth of modules) in the Ontario Universities Program in Field Biology (OUPFB). 1.5 of these modules were presented by Queen's instructors and 9.5 by instructors from other institutions (one course was a collaborative effort between Queen's and Ottawa U.) Details of the OUPFB programme are found in Tables 1 and 2 (pp. 26 - 27). In addition to the OUPFB modules, Dr. Scott Ramsay (Wilfrid Laurier University) brought his field course for senior undergraduates for two weeks in late summer. This is the 18th edition of the course and Dr. Kott attended (probably for the last time), having now retired and handing the reins over to Dr. Ramsay (himself a QUBS alumnus). Jim Ludden (also a QUBS alumnus) brought a midsummer field course to QUBS from College of DuPage (Glen Ellyn, Illinois). In addition, two Ecological Land Classification Courses offered by the Ontario Ministry of Natural Resources and Gartner Lee Associates were hosted by QUBS. The first was in summer, the second in early fall.

In 2005, field trip and conference use of QUBS remained at high levels. It would seem that the possibilities of the venue has been recognized and QUBS has become a frequent destination. A summary of conference, meeting and field trip use of QUBS in 2005 appears later in this report (pp. 63 - 65).

Change in Directorship of QUBS

After 33 years as Director of Queen's University Biological Station, Dr. Raleigh Robertson has retired from that post. Dr. Bruce Tufts has stepped forward as the new Director. There were two events held in summer to mark this change of leadership and to thank Raleigh for all of his efforts over the years.

On June 30, 2006 there was a "handing over the reins" during a seminar night at QUBS. Raleigh was asked to address the group of regulars, recapping his time as Director and highlighting the significant changes at QUBS during his tenure as Director.



Dr. Raleigh Robertson shakes hands with Dr. Bruce Tufts after handing over the "keys to the kingdom" - June 30, 2005 (Lois Robertson photo)

After the "handing over", the new Director, Dr. Bruce Tufts addressed the group, answering the question "Who is this guy?" and giving his view of the Directorship and his role in the continued success of the field station.

During the Departmental Picnic on July 29, there was a second opportunity to thank Raleigh for his efforts and to mark the change of Directorship. In late afternoon, the crowd of QUBS regulars and Department members were asked to gather around the front deck of the Operations Centre. Frank Phelan, Manager of QUBS, as one who has worked with Raleigh for over 30 years, was asked to recap Raleigh's tenure as Director. The following is the rough outline of Frank's comments:

"I was one of Raleigh's first field assistants, one of his first graduate students at Queen's and Manager for 30 of his 33 years here at QUBS. In short, I have been around to closely observe his career at Queen's, thus I was asked to give my perspective on his time as Director of QUBS.

First and foremost, Raleigh has always been thoughtful and deliberate and ever the consummate gentleman in all his connections with people of all stripes. This is something that all of us should emulate in our own dealings with people.

During Raleigh's tenure, QUBS has advanced from small outpost to a large, thriving centre for research and teaching in the biological sciences, including a fourfold increase in user-days. In addition, QUBS has developed an international reputation as a quality field station.

Among his achievements is the enrichment of programs at QUBS, including field courses, with Queen's and QUBS involved in the consortium of 14 Ontario Universities (OUPFB - Ontario Universities Program in Field Biology), outreach (eg. the Open House, held for each of those 33 years and the Community Newsletter, started 23



Dr. Raleigh Robertson, Dr. Mel Robertson and Dr. Bruce Tufts - July 29, 2006 (Lois Robertson photo)

years ago), workshops, field trips, and research, both by Queen's personnel and researchers from many other Canadian and international universities.

Raleigh has spearheaded the development of facilities to match the needs of QUBS users of all kinds. There has been a doubling of built infrastructure during tenure. Throughout, Raleigh has been insistent on doing so in a careful, sensible manner. Behind all of this is the need to finance change and development. Raleigh has become skilful at getting money wherever possible. Admittedly, this has been an ongoing learning process, discovering sources wherever available and tapping into such things as NSERC Major Facilities Access Grants (MFA - QUBS has held MFA grants for some 21 years with Raleigh as main applicant), Canada Foundation for Innovation Grants (CFI - projects like the Operations Centre behind me here, with Raleigh as lead applicant), special funds at Queen's, fundraising for special projects like land acquisition, renovations and alterations (R&A - Queen's) etc. Countless hours have been spent developing contacts, preparing applications and administering projects over his time as Director. Most are completely unaware of these time-consuming, behind-the-scenes activities.

Arguably the most significant achievement of Raleigh's time as Director has been in developing a landbase sufficient to provide opportunities for teaching and research into the future. This is especially important in the busy, developing Rideau corridor surrounding QUBS. A series of acquisitions have often been the result of careful planning and negotiation. Not always, however. Sometimes they are almost spontaneous, like the frantic summer Friday afternoon in 1988, when Raleigh and I with Allen Keast as chauffeur (imagine the peril associated with that!) managed to wrest the back half of Cow Island from another would-be buyer, securing the deal with a personal cheque before banks closed. On the other end of the spectrum, long periods of negotiation, proposals, briefs to potential partners and fundraising resulted in the securement of large blocks of property which, by design or chance, have come together like a jigsaw puzzle to provide the diverse landbase of QUBS. Currently, the 2,768 hectares owned by QUBS makes it the largest inland field station in Canada. Not that this process has stopped, there are still several irons in the fire and undoubtedly more on the horizon. Raleigh, in his capacity as Baillie Chair of Conservation Biology, intends to maintain his involvement in land acquisition and management.

Another significant achievement has been the establishment of a QUBS Land Trust to provide necessary funds for ongoing management of existing properties and the securement of other vital properties.

As already mentioned, with the interest and generosity of the Baillie Family, Raleigh secured the Baillie Chair in Conservation Biology, explicitly linked to the field station, to ensure Raleigh's continuing involvement with the field station and which will promote opportunities at QUBS in this important, emerging field.



Dr. Raleigh Robertson with his presentation portrait (Celine Muis Griffin photograph)

Raleigh has heightened the profile of QUBS at every opportunity, both inside the university, within the province, within Canada and on the world stage.

I must admit that it has been a pleasure working with Raleigh over three decades. Please, a large vote of thanks for all his efforts which have often gone unnoticed outside the circle of QUBS staff and regulars. Raleigh should be deservedly proud of his accomplishments with respect to the field station. Please join with me in thanking Raleigh..."

Raleigh then addressed the group. In his usual manner, Raleigh graciously and self-deprecatingly thanked one and all who worked with him, assisted him with projects and supported him in his efforts. These included coworkers, staff and friends of QUBS and his family, especially his wife, Lois.

Dr. Mel Robertson, Chair of the Department of Biology, then thanked Raleigh for his years as Director and presented him with Bernard Clark photographs taken at QUBS. One of these will hang in the lodge/operations centre as a lasting tribute to Raleigh and the other is to be kept by Raleigh as a keepsake.

Death of Joe Brown

In fall, we were shocked to hear of the untimely death of Joe Brown, an alumnus of QUBS and an unforgettable member of the QUBS community. Our sympathies go out to Faye Murrin and Joe's family and friends. Joe will live on in the lore of the field station. There is no one like Joe.

The tribute on the following pages is taken verbatim from the Canadian Journal of Fisheries and Aquatic Sciences, Vol 63, Number 5, May 2006 pps. iii-iv (ISSN 1205-7533). Also available at http://pubs.nrc.gc.ca/cgi-bin/rp/rp2_tocs_e?cjfas_cjfas5-06_63.

"Many in the fish biology community were shocked to hear of the sudden death of Dr. Joseph Brown, or Joe as he preferred to be called, at his home in Shoe Cove, Newfoundland, on 3 September, 2005. An American at birth, a Canadian by choice, and a true Newfoundlander at heart, Joe was an outgoing and humorous individual who became the social centre of nearly every room he walked into. It is for this as much as his professional achievements that his absence will be felt the most.

Joe's university training began shortly after he completed high school in Maine, when he came to Canada and obtained a B.Sc. at St. Francis Xavier University (Antigonish, Nova Scotia) in 1968. He then served for two years in the US army by "invitation". Fortunately for all concerned, "G.I. Joe" caught pneumonia during basic training and served as an army clerk in Germany instead of an infantryman in Vietnam. An opportunity afforded by the G.I. Bill soon led him to begin graduate studies at Memorial University of Newfoundland (MUN, St. John's, Newfoundland), where he initially worked with Dr. John Lien on seagull behaviour but soon became interested in the behavioural ecology of fishes. Under the guidance of Dr. John Green, Joe studied aggression and territoriality in the Arctic shanny (*Stichaeus punctatus*) and received his M.Sc. in 1976. His first paper was also published in that year (J.A. Brown and J.M. Green, *Can. J. Zool.* **54**:1904-1907 (1976)). After two years working as a farm labourer, laboratory demonstrator, and museum curator in Nova Scotia, Joe moved to Kingston, Ontario.

As a Ph.D. student with Dr. Patrick Colgan at Queen's University (Kingston, Ontario), Joe studied the ecology and ontogeny of feeding behaviour and predator avoidance in young-of-the-year centrarchids. In collecting observational data for this work, Joe spent many hours in front of experimental aquaria while at the Queen's University Biological Station on Lake Opinicon, Ontario. As his work continued at the station, he gradually took over an entire building, affectionately known as the "Joe Brown Palace", with his holding tanks (a scientific term for "plastic kiddie pool") and observational aquaria. He received his Ph.D. in 1983 but stayed at Queen's for an extra year as a postdoctoral fellow with Dr. Peter Johansen, a fish physiologist and toxicologist. It was here that Joe began to show his ability and desire to apply his knowledge and interest in the behaviour and ecology of the early life stages of fish to other fields of study. He published five papers on the effects of the environmental contaminant pentachlorophenol on juvenile fish.

The next major phase of Joe's career began when he returned to MUN to rejoin Dr. Green's laboratory as a research associate. He was appointed to the faculty of the Ocean Sciences Centre (then the Marine Sciences Research Laboratory) in 1985. Joe's terms of reference in appointment were to set up a strong research program in his field, the behavioural ecology of fish, and to use this as a platform to support the emerging aquaculture industry in Newfoundland. The bulk of Joe's contribution in the area was still a decade away, however, as he and his students worked on a different problem. Towards the end of the 1980s, a growing body of work demonstrated significant kin discrimination abilities based on waterborne chemosensory cues in a variety of freshwater fishes. Joe's laboratory was among the first to demonstrate that kin discrimination occurs as a result of learned phenotype matching (G.E. Brown, J.A. Brown and A.M. Crosbie, *Anim. Behav.* **46**: 1223-1225 (1993)) and that the recognition of full siblings in the presence of unrelated conspecifics is dependent upon the relative concentrations of odour present (M.J. Hiscock and J.A. Brown, *Can. J. Zool.* **78**: 278-282 (2000)). Joe and his collaborators then examined the functional benefits associated with kin discrimination in juvenile salmonids, publishing 11 papers on this topic (eg., G.E. Brown and J.A. Brown, *Anim. Behav.* **45**: 863-871 (1993); G.E. Brown and J.A. Brown, *Behav. Ecol.* **7**: 24-29 (1996)). Other significant fields to which Joe contributed include juvenile cod - habitat interactions, environmental - genetic components to phenotypic variation, and comparative physiology - ecology of marine organisms using lipid biochemistry.



Joe Brown (shown here in front of the cliffs that were outside his office in Logy Bay, Newfoundland)

From his earliest work, it was clear that Joe always took a broad view of basic research questions, stressing the importance of both the proximate (mechanistic) and ultimate (evolutionary) causation of specific behavioural patterns. For him, it was not enough to ask "how" but also "why". This resulted in a significant contribution to understanding the feeding behaviour and ecology, habitat use, and predator avoidance of young fishes. Among other achievements, Joe and his students were among the first to test rigorously the predictions laid out in G.S. Helfman's (*Behav. Ecol. Sociobiol.* **24**: 47-58 (1989)) model of threat-sensitive predator avoidance, thereby making great inroads towards linking proximate and ultimate causation. For example, Bishop and Brown (T.D. Bishop and J.A. Brown. *Behav. Ecol. Sociobiol.* **31**: 133-139 (1992)) demonstrated that larval threespine sticklebacks (*Gasterosteus aculeatus*) shift from risk-averse to risk-taking foraging, depending upon predation risk. In addition, they clearly demonstrated that this shift is linked with the development of bony spines, a morphological predator deterrent. Similarly, Williams and Brown (P.J. Williams and J.A. Brown. *Mar. Ecol. Progr. Ser.* **76**: 53-60 (1991); P.J. Williams and J.A. Brown. *Mar. Ecol. Progr. Ser.* **88**: 185-193 (1992)) linked morphological development and predator avoidance in the larvae of several marine fish species.

Clearly, understanding the feeding ecology and social interactions of larval and juvenile fishes conferred on Joe and his students a particular advantage in developing a large aquaculture research and development program at MUN in the late 1990s. After all, determining ideal conditions for feeding and minimizing the negative consequences of agonistic interactions under crowded conditions are crucial for the successful rearing of fishes in a viable aquaculture enterprise. Some of the techniques developed in Joe's lab have been adopted worldwide, with little or no modification (J.A. Brown, G. Minkoff, and V. Puvanendran. *Aquaculture*, **227**: 357-372 (2003)). This aquaculture phase of Joe's career began with a project on Atlantic halibut (*Hippoglossus hippoglossus*) that was funded by the Natural Sciences and Engineering Research Council of Canada. This was followed by work on yellowtail flounder (*Limanda ferruginea*), a collaboration with Fishery Products International and the Canadian centre for Fisheries Innovation, and brief work with witch flounder (*Glyptocephalus cynoglossus*), Arctic char (*Salvelinus alpinus*), and wolffishes (*Anarhichas* sp.). Perhaps the most publicized research, however, has been related to Atlantic cod (*Gadus morhua*), beginning as a collaboration with Sea Forest Plantation and later with the governments of Canada and Newfoundland and Labrador and with several industry partners. Joe and his colleagues published 35 peer-reviewed papers from this applied research. He was named Researcher of the Year by the Canadian Centre for Fisheries Innovation in 1998 and received the Research Award of Excellence from the Aquaculture Association of Canada in 2001. In 2002 the Canadian Foundation for Innovation formally recognized Joe as one of Canada's leading aquaculture scientists. He played a major role in the establishment of the Aquaculture Research and Development Facility at MUN, which was no mean achievement, as it required close and effective liaison among the academic, government and private sectors.

Joe published widely throughout his career (110 peer-reviewed papers published over a 30-year period). He obtained 55 research grants, which brought in a large amount of funding to MUN. To his colleagues, Joe was a tireless, consummate "team player" who did not shirk administrative tasks, serving on numerous departmental and university committees, as well as those of national research programmes such as AquaNet. He was President of the Aquaculture Association of Canada and Chair of the Ecology, Ethology and Evolution Section of the Canadian Society of Zoology and sat on numerous review boards and panels.

It was as an advisor and mentor of students, however, that Joe made his most enduring contribution. He was devoted to both undergraduates and graduates, and they to him. Students flocked to join his group, and his large "stable" of graduate students became one of the pillars of MUN's Ocean Sciences Centre. Despite a relatively short career, Joe supervised 72 theses (20 Ph.D., 34 M.Sc., 18 B.Sc. Hons), 16 of which were in progress at the time of his death. He attracted many students from afar, especially from developing areas including Brazil, India, Indonesia, Malawi and Sri Lanka. He always had time for students, both in the laboratory and outside, and they were a central part of his lively social life. Joe gave them complete freedom to design their experiments: enough rope to do what they wanted, but not enough to hang themselves. This approach produced numerous independently thinking individuals, and many of Joe's students have gone on to academic, governmental science, or environmental consulting positions.

Joe will be sadly missed not only by his family, but also by his wide circle of friends, colleagues, students, and former students. The warm sentiments expressed at the gathering of family, friends, and colleagues to celebrate his life confirm that his work, but especially his friendships and his love of life, will be his legacy.

For more information about Joe's publications and the Dr. Joe Brown Scholarship Fund, please visit <http://www.osc.mun.ca/>.

C.F. Purchase, H.P. Benoit, D.L. Boyce, G.E. Brown, V. Gotceitas, B.J. Laurel, V. Puvanendran and R.J. Thompson

New Barn Demolition

For some time, the New Barn (opposite the Opinicon Cemetery) has been slowly deteriorating. The southwest corner of the foundation has collapsed, threatening the overall stability of the structure. Were it not for the steel jackposts installed in the lower level by Frank Phelan and David Hughson some years ago, the barn would almost certainly have fallen down. With the collapse of the foundation wall, however, the deterioration was proceeding at a faster rate and a decision of whether to repair or remove was forced upon us. Regrettably, with tight fiscal times, we could not afford proper repairs. These would, at best, be stopgap since an unused barn without heat of cattle to keep out frost would continue to deteriorate.

Discussions with a series of potential contractors led us to Derek Rab, a local builder who reclaims barn structures for reuse. A deal was struck whereby Derek would keep the building materials in exchange for demolition of the barn and cleanup of the site.

The process began January 14, 2005 and was finished by May 2005. The following is a series of photographs of the process (Frank Phelan photographs).



December 2004 - north face (roadside) seen from the Opinicon Cemetery
Below: January 2005 - start of demolition - seen from southeast





December 2004 - south face - seen from middle of New Barn Field
Below: February 2005 - only frame timbers left



During the demolition, it was decided to leave some remnants of the barn as a reminder. Thus, the two corners of the stacked stone foundation nearest the road were left intact. The site was levelled and seeded with pasture mix to both control weeds and erosion. A two-rail split-rail cedar fence was built alongside the road and a triangular monument rock put in place.

Discussion with the Hughson Family (primarily Wayne and Connie) led to us having a commemorative plaque made in memory of George and Beatrice Hughson, the Hughson family and the New Barn itself. The photo below shows the plaque in place at the site in spring of 2006 (Gary Bell photo).



The plaque reads:

"The Hughson Farm"
currently part of *Queen's University Biological Station*
so named in recognition of
George Hughson (1921 - 2003) and
Beatrice Hughson (1928 - 2003)
And the entire Hughson Family,
Good Friends and Neighbours
Erected on the site of the "New Barn" (1919 - 2005)

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

Message from the Chair

I am a strong advocate of field courses to improve our understanding of issues in conservation biology and of field research to provide solutions for conservation problems. As holder of the Baillie Family Chair in Conservation Biology, I work hard to ensure that Queen's University provides first-hand experience to students in the context of small, intensive field modules, and at the same time offers first-rate facilities and logistical support to researchers through programs at the Queen's University Biological Station (QUBS).

The Baillie Family Chair in Conservation Biology has been very beneficial in raising the profile of Queen's programs in this very important discipline. QUBS has continued to host numerous field courses, many of which incorporate a conservation theme woven through studies of various aspects of ecology. My own research at QUBS deals with two species of conservation concern, and the research programs of scientists from many institutions continue to provide insights into natural systems that will help address conservation issues.

We at Queen's, especially those of us who teach and study at QUBS, want to express our gratitude to the Baillie Family for their generous gift that sponsors the Chair, and our respect for their very farsighted and sincere commitment to conservation and to Queen's.

Research Activities

During the spring and summer of 2005, I supervised a number of field studies on the behavioural ecology and conservation biology of birds, most of which were conducted at the Queen's University Biological Station. All of the studies included graduate and/or honours students and thus contributed to the training of highly qualified personnel while at the same time addressing issues of conservation concern. In addition, I think the students learned a great deal, experienced significant personal growth, and had lots of fun!



The Cerulean Warbler has a productive breeding population at QUBS, although it has been declining throughout its range. Our studies seek to establish habitat requirements, including minimum size forest tracts required for occupancy by this poorly understood species. (photo by P-G. Bentz/Sturnus)

Research Projects

- ❑ Graduate research project on the Golden-winged Warbler (Rachel Fraser) - to determine the role of hybridization with Blue-winged Warblers in the population declines of Golden-wings.
- ❑ Collaborative research project with Dr. Jason Jones, Vassar College, on Cerulean Warblers in habitats in regions outside the core breeding area at QUBS.
- ❑ Graduate program of Javier Salgado Ortiz - breeding and conservation biology of the Mangrove Warbler, at Celestun, Mexico.
- ❑ Graduate program of Brian Campbell - study of the effects of habitat fragmentation and agro-forestry practices on the bird community in the Atlantic forest of Brazil.
- ❑ Graduate program of Mary Stapleton on a study of the role of genetic compatibility in mating patterns of Tree Swallows.
- ❑ Continuation of long-term studies (<30 Years) on Tree Swallows as part of the "Golondrinas of the Americas" project.
- ❑ Graduate program of Devia Aiama, co-supervised by Dr. Gary Van Loon, with field studies in India. Goal is to assess effects on biodiversity of different agricultural practices in villages in the hill region of southern India.
- ❑ Field study with Prof. Jan Lifjeld's students, Oddmund Kleven & Frode Jakobsen, University of Oslo, Norway - research on Barn Swallow paternity in relation to colony size and sexually selected characters such as colour and tail length, with study sites at and near QUBS.



Raleigh Robertson, and students in the field course "Behavioural Ecology and Conservation Biology of Birds" observing birds on the QUBS Massassauga Creek Conservation Reserve

Teaching

Behavioural Ecology and Conservation Biology of Birds

In spring 2005, I taught "Behavioural Ecology and Conservation Biology of Birds" at the Queen's University Biological Station, May 1 - 14 (2005) with an enrolment of 9 students from Queen's as well as other universities in the Ontario Universities Program in Field Biology.

Having the opportunity to work with the very energetic, bright, and highly motivated students continues to be truly inspiring for me as a professor. It's a joy to witness the student's enthusiasm for learning and their excitement of experiencing hands-on conservation biology.

William C. Brown Research Endowment Fund

The Bill Brown Research Fund continued to play a very useful role in supporting programs of research and teaching at QUBS. The funds were used for a combination of student support and field logistics, as well as covering the costs of accommodation for honours students at QUBS.

The Queen's Land Trust

The Queen's Land Trust has now exceeded a capital balance of \$200,000. 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.

Dr. Allen Keast

Once again, Dr. Allen Keast made kind donations to QUBS, which allow us to improve both our facilities and our programs. Allen's long-term support, both intellectually and financially, continues to make an important contribution to our overall efforts at QUBS. This support is greatly appreciated.

NSERC and Other Support

2005 was the 22nd year that QUBS has held a Major Facilities Access Grant (MFA) from NSERC (Natural Sciences and Engineering Research Council) (including the years of MFA's precursor, the Infrastructure Grant). 2005 was the final year of the latest award. A new application was filed in fall to cover the upcoming three years. As luck would have it, this application was the first task undertaken by the new Director, Dr. Bruce Tufts.

This grant pays the salary of QUBS Assistant Manager (Floyd Connor) and half of the Maintenance Assistant (Roger Green) salary and benefits. The Assistant Managers' benefits are paid by Queen's. For 2005, we moved to make the Maintenance Assistant's position a continuing position. Thus, we had the position evaluated and set the parameters at 85% of full time, continuing. By doing so, Roger is now able to tap into the benefits offered by a continuing position at Queen's. In addition to salary and benefits, the MFA contributes to the cost of shared services (eg. electricity) and infrastructure.

The MFA award recognizes the productivity and excellence of a multi-university initiative. With researchers at QUBS coming from many Canadian, American and International universities, a collaborative atmosphere of inquiry and interaction is created at QUBS, enhancing the experience for everyone involved. This atmosphere leads to creative interaction and discussion, which, in turn, sparks users to be innovative in carrying out quality research.

Dean's Equipment Fund

In autumn of 2004, QUBS submitted a proposal requesting funds from the Dean's Equipment Fund to enable the purchase of several items of equipment to enhance the teaching and learning environment at the Station. In early January of 2005, we were pleased to learn that our request had been funded in full and we began to purchase and use the new equipment. Items were in three main categories, as follows:

Weather monitoring equipment consisted of 1) a #61205V RM Young Barometric Pressure Sensor (from Campbell Scientific), the first recording electronic air pressure gauge owned and operated by QUBS, 2) a #52202-10-L RM Young Tipping Bucket Rain Gauge with heater, to record water equivalent of precipitation throughout the year, and 3) a Samsung SyncMaster 910v 19-inch TFT LCD flat panel computer monitor to display incoming weather data using our new RTDM (Real Time Data Monitoring) software from Campbell Scientific as well as displaying microscope images (see below).

Two digital microscopes were purchased, to identify and observe aquatic and terrestrial organisms with entire groups of students. These were 1) a #57900-01 Boreal Digital Skope (Compound) from Boreal Labs and 2) a #57900-02 Boreal Digital Stereomicroscope from Boreal Labs. Because of a small decrease in the price of these items, we were able additionally to afford a graduated mechanical stage for the compound microscope.

Field collecting equipment was the final category of items purchased with these funds. Four new pairs of "Bushlite" chest waders, the first new waders owned by QUBS in a very long time, were purchased from Le Baron Outdoor Products Ltd. Finally, a new Ward's D-Frame aquatic net and replacement net bags will greatly improve our benthic sampling capabilities, and our new Ward's Student Plankton Net with 80 micrometer mesh size will enable us to do fairly broad-spectrum introductory sampling of plankton (which we have been unable to do until now).

Warner Lake Ecological Observatory (WLEO)

In the fall of 2003, a fixed-station acoustic telemetry observatory was installed in Warner Lake as a collaboration between Queen's University, QUBS biologists, and industry (Lotek Wireless Inc.). Since the installation of the telemetry array there have been multiple deployments of transmitters (see Table A) for use in a range of basic and applied studies. To date, there have been a number of students trained as a result of this research activity. In 2005, Kyle Hanson (University of Illinois) completed a Master's thesis using data obtained from the observatory. Kyle investigated the seasonal activity of largemouth bass, as well as their depth distribution. Caleb Hasler completed an undergraduate thesis (Queen's) investigating associations among individual largemouth bass using data obtained from the observatory. Manuscripts based on these theses are currently in review and Kyle and Caleb are both still involved with the observatory as graduate students (PhD at Carleton and MSc at Queen's, respectively).



Caleb Hasler holding a largemouth bass fitted with an externally attached transmitter.

In January 2005, the first peer-reviewed publication focusing on the observatory was published in *Marine Technology Society Journal* and titled "Use of CDMA acoustic telemetry to document 3-D positions of fish: Relevance to the design and monitoring of aquatic protected areas". The paper provides crucial conclusions on the accuracy of the WLEO positional data and the application of positional data in fisheries research and management. A paper entitled "Fine-scale temporal and spatial analyses of largemouth bass behaviour using a 3-D whole-lake acoustic telemetry observatory" has also been accepted for publication in the journal *Hydrobiologia* as part of the proceedings from the European Telemetry Conference. The manuscript highlights the ability of the array to gather data in unprecedented detail throughout the year. Presentations based on work completed at the array have been given at multiple conferences including American Fisheries Society, Canadian Conference for Fisheries Research, the European Telemetry Conference, and the inaugural Queen's University GIS day. During January, the WLEO was also visited by Lotek Wireless Inc. and a biologist from Denmark who had purchased a similar system. The group used the WLEO to learn how to install and optimize their new system.

In the summer of 2005, a study to determine the displacement behaviour of angled nesting largemouth bass was initiated. Nesting fish were angled, equipped with an external 2.5 second repetition rate transmitter, and subjected to various stressors inherent in a typical angling event. Preliminary data analysis revealed some fish, if treated as if they were angled and held during a fishing tournament, will not return to their nest, while fish promptly returned to the water in close proximity to their nest will resume parental care activities. Also, the possibility of intragastric tagging of largemouth bass so as to remove the need for internal surgery or external attachment was attempted, but ultimately tag retention was too low to make this a viable practice (due to regurgitation).

Positional data are continuously being collected, providing a huge database for a variety of studies. Archiving data on multiple fish throughout the year has been ongoing since the installation of the array in 2003. This year (October 2005), twenty largemouth bass were implanted with long term, 1 minute repetition rate transmitters that will provide positional data on the same individual for the next three years. Programming errors rendered ~50% of the transmitters useless for 3-dimensional positioning. The remaining 10 tags were utilized for a project that analyzed winter acclimation in largemouth bass by correlating physiological changes in metabolism with activity and distribution.

In the fall and winter of 2005, 22 sites throughout Warner Lake were sampled for dissolved oxygen and temperature to gain background data on key lake environmental variables believed to affect largemouth bass behaviour during the winter months. Also, ~35 temperature loggers were deployed throughout the lake to collect temperature readings every four hours over the course of the next year. Preliminary analyses of these data have revealed that largemouth bass are restricted to particular areas of the lake and often choose warmer and more oxygenated areas.

Future work includes investigating the effects of anthropogenic issues (such as recreational boating and shoreline development), seismographic disturbances, and variable weather patterns on bass behaviour. In addition, we intend to shift to a community based research focus by tagging other species of fishes, as well as snapping turtles.



Kyle Hanson drilling a hole in the ice in order to sample for dissolved oxygen and temperature.

Investigators and Collaborators

Dr. David Philipp *Program in Ecology and Evolutionary Biology, University of Illinois, and Center for Aquatic Ecology and Conservation, Illinois Natural History Survey, 607E. Peabody Drive, Champaign, IL, USA, 61820.*

Dr. Steven Cooke *Department of Biology and Institute of Environmental Science, Carleton University, 1125 Colonel By Drive, Ottawa, ON, Canada, K1S 5B6.*

Dr. Bruce Tufts *Department of Biology, Queen's University, Kingston, ON, Canada, K7L 3N6.*

Dr. Cory Suski *Harkness Laboratory of Fisheries Research, Ontario Ministry of Natural Resources, 300 Water St., Peterborough, ON, Canada, K9J 8M5.*

Dr. George Niezgoda *Director Research and Development, Lotek Wireless Inc.*

Frank Phelan and Floyd Connor *Queen's University Biological Station, Department of Biology, Queen's University, Kingston, ON, Canada, K7L 3N6*

Graduate Students

Kyle Hanson *Department of Biology and Institute of Environmental Science, Carleton University, 1125 Colonel By Drive, Ottawa, ON, Canada, K1S 5B6.*

Caleb Hasler *Department of Biology, Queen's University, Kingston, ON, Canada, K7L 3N6.*

Table A. Summary of tagging deployments for largemouth bass in Warner Lake

Event	Transmitter Model	Sensors	Pulse Interval	Date of Tagging	Method of Attachment	Number of Tagged Fish	Approx. Life Expectancy	Primary Purpose of Study
1	CTPM 11-25	Temperature Pressure	15s	10/14/03 – 10/15/03	Internal	Males, N=13 Females, N=9	~280 days	Proof of concept and field validation Seasonal spatial ecology study, focus on winter period
2a	MA-TP 16-25	Temperature Pressure	10s	10/8/04 – 10/9/04	Internal	Males, N=10 Females, N=9	~330 days	Seasonal spatial ecology study, focus on year round period
2b	CTPM 11-25	Temperature Pressure	15s	10/8/04 – 10/9/04	Internal	Males, N=5 Females, N=2	~280 days	Seasonal spatial ecology study, focus on year round period
3	MAP 11-25	None	2.5s	5/9/05 – 5/31/05	External	Males, N=22	~30 days	1. Assessment of parental care behaviour 2. Assessment of impacts associated with catch-and-release angling 3. Testing transmitters with short burst rates
4	MA-TP 16-25	Temperature Pressure	60s	10/5/05 – 10/6/05	Internal	Males, N=11 Females, N=9	~3 years	Long term spatial ecology and reproductive dynamics study

SCHOLARSHIPS AND BURSARIES

Alexander and Cora Munn Summer Research Award

Emily McKinnon received the Alexander and Cora Munn Summer Research Award for her work at QUBS on Golden-winged Warbler conservation biology. This award, established as an endowed fund by Alexander and Cora Munn, is to help provide opportunities for students in third or fourth year of a program involving Conservation Biology to work in a research environment at QUBS, especially in the areas of woodlot management and/or wildlife conservation.

QUBS Outreach Programs

Seminars

Planning the seminar series was a joint effort between Frank, Karen Mack (SWEP Outreach Coordinator) and Shannon McCorquodale (local cottager and long-time friend of QUBS). An initial brainstorming session of potential topics and speakers formed a framework for filling out the schedule. We did have some difficulty with scheduling, so there were gaps in the program. It seems that everyone has a very busy life these days. A full list of speakers and topics is found later in this report (pp. 61 - 62).

The season kicked off with a series of speakers from visitors to QUBS at the invitation of Dr. Raleigh Robertson, holder of the Baillie Chair in Conservation Biology.

The early seminars in the series are generally aimed at QUBS regulars. Later in the series, topics and speakers are generally geared for a wider audience, friends and neighbours, visitors to the area and the Friends of Opinicon. Shannon McCorquodale and Sue MacLachie helped advertise the seminars to these groups.

The seminar series has become popular with this wider group and has become a mainstay of QUBS outreach programming.
Suggestions for speakers and topics are always welcome.

Open House

The 35th annual Open House was held on July 3, 2005. Approximately 400 visitors attended. QUBS regulars offered tours of the station and displays of current research projects. Although we see many of the same faces year to year attending, there are always new people finding us on their own or being brought by regular attendees. Comments of visitors are usually positive, finding it informative and interesting and enjoying the opportunity of asking questions of those directly involved in field research.

The Open House is a significant outreach effort of QUBS, only made possible by the efforts of our regulars. Karen Mack (SWEP Outreach Coordinator and Information Manager for 2005) was instrumental in organizing the day, providing logistical support and equipment to those mounting displays. A great deal of credit belongs to the QUBS Regulars who worked hard to develop displays and who were our ambassadors for the day. The public obviously has a great interest in QUBS and its activities. The public benefits in close contact with the researchers, learning about local flora and fauna while our researchers learn a lot about public perception and interests.

The 2005 version of the Community Newsletter (24th edition) was distributed to some 1370 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

Again in 2005, there was one GIS (Geographical Information Systems) and GPS (Global Positioning Systems) / Field Biology assistant at QUBS, jointly sponsored by Queen's SWEP (Summer Work Experience Program) and QUBS, and filled by Eric DeLong. Eric was a returning undergraduate student pursuing his 2nd and 3rd degrees in Environmental Science and Geographic Information Management Studies, and came to us with a wealth of experience from his previous work as a GIS Specialist for an environmental consulting firm in Whitehorse, Yukon. Prior to his arrival, Eric researched and acquired numerous governmental base data sets through channels at the Queen's Map and Air Photo library. His first task upon arriving at QUBS was to set about organizing these new datasets into an intuitive folder structure, and then to update the "Quick Maps" (QM's) constructed the previous year to reflect the newly acquired base data. These new data were edited to update areas such as islands, lakes and other geographic features with local QUBS names; these features were tagged with their name within the database behind the base data, so that the features could be labelled dynamically. The former use of static labels was restrictive as they are tied to a single location. Dynamic labels will move as users zoom and pan around the data within the GIS software, resulting in increased convenience and more efficient map production. New 8.5"x14" QM's were produced by the end of the season complete with shaded relief (when possible), detailed legend, regional overview inset map, and production details. Finally, an overview "Index" map was produced showing the location of each QM. Each was presented in a colour scheme both eye-catching and conducive to use by researchers in the field.

One of Eric's notable contributions was to refine the structure for storage of GIS data and the setup for individual projects to render it more intelligent and intuitive from its previous incarnation as a hodgepodge of data

and projects often stored in obscure locations. This strict folder scheme was based on his experience in industry and proves to be helpful and efficient at locating data and projects. The methods were documented and should be adhered to in following years to maintain consistency.

Eric produced several mapping projects for QUBS through the season, and ranged from the straightforward to the complex where primary data collection was necessary. Highlighted maps include:

- Bird grids in and near QUBS properties for Dr. Mary Stapleton (Queen's University)
- Data collection and mapping for bass nesting sites at Warner Lake and Millers Lake, and bluegills at Long Lake
- Bathymetry maps of Lake Opinicon for Gregory Bulté (University of Ottawa) using data collected the previous year
- Updated mapping of QUBS properties for internal use and to be included in publication by Dr. P-G Bentz of the Falsterbo Bird Observatory in Sweden.
- Microphone locations for black-capped chickadee array (Dr. Dan Mennill and Lauren Reed (Windsor) and Jen Foote (Queen's))
- Cerulean warbler habitat fragment maps for Dr. Jason Jones (Vassar College)
- Data collection and mapping of exclusion plots at the Massassauga property for researchers at the University of Virginia/Georgia Southern University.

Eric's previous experience allowed for improvements to be made to the way the GIS/GPS Field Biology position was run. His pro-active approach to offering his services to a diversity of users helped facilitate research at QUBS, and his cheerfulness and enthusiasm will be missed. As this report goes to press, we are hopeful that he will be back studying at Queen's University, beginning a Master's degree with Dr. Linda Campbell in the Aquatic Ecosystems Health Laboratory on research that combines contaminants in Ontario fish and GIS analysis.

Outreach Coordinator/Information Manager and SWEP

Karen Mack was the Outreach Coordinator and Information Manager in 2005. This position is funded by Queen's SWEP (Summer Work Experience Program) and QUBS. Karen assisted with many facets of outreach and organization.

Karen helped organize the summer seminar series. With the help of local cottager Shanon McCorquodale, seminars were advertised and the Friends of Opinicon called to keep them informed of the scheduled seminars.

Karen produced the Community Newsletter which was circulated widely in the locality. Karen also assisted with all aspects of the Open House, helping regulars with equipment for displays and being on hand to welcome visitors to the Open House.

Further work was done on the Boardwalk Trail, a project started by Liesha Mayo-Bruinsma the previous year. Most of the interpretive material was developed and signage prepared. Although the signs were not actually produced, they have been laid out at Jet Signs. Karen developed a series of stops along the trail to illustrate specific points, trees were identified with the help of Brandon Schamp and a self-guide brochure mocked up, ready for printing.

Karen spent considerable time researching available material on the history of the area, both cultural and biological history, as part of a project to document changes over time. This is a long-term project which will better enable QUBS users to understand how the region and its flora and fauna have changed over time.

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 - Marg Phelan, Cheryl MacDonald, Veronika Jaspers-Fayer and Stuart Davison and our Cleaning Staff, Cathy Warwick. Thank you also to kitchen helpers/dishwashers Nik Larson and Ron Vinkle who helped at especially busy times.

QUBS Properties

Hughson Farm

In 2005, the Hughson Farm was used for studies of Tree Swallows, Cerulean Warblers, American Redstarts, Golden-winged Warblers, Red-winged Blackbirds, Black Rat Snakes, Map Turtles, damselflies, dragonflies, hoverflies, water mites, Largemouth Bass, Smallmouth Bass, Bluegill, Pumpkinseed, plant competition, old field succession, leaf size in plants, plant invasiveness and colonization, the possible effects of bismuth on forests and wetlands, dendrochemistry, the isotopic composition of precipitation and surface waters and nitrogen cycling.

The various bird box grids were again used by Dr. Raleigh Robertson and his 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 and a large plot in the center of the Cemetery Field were intensively used for plant competition studies.

Haying of the open fields was done by Bob Butterill and Roger Green in 2005.

The New Barn was removed and a memorial to the Hughsons erected on the site (details elsewhere in this report).

Bonwill Tract

The Bonwill Tract was used for studies of Cerulean Warblers, American Redstarts, the genetic diversity of birds, Spring Peepers, Black Rat Snakes, damselflies, dragonflies, water mites and the isotopic composition of precipitation and surface waters in 2005.

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.

Haying of the open fields was done by Bob Butterill and Roger Green in 2005.

John M. Cape - Charles Sauriol Environmental Studies Area

The Cape-Sauriol Tract was used for studies of Black Rat Snakes, Map Turtles, Largemouth Bass, Smallmouth Bass, Bluegill, Pumpkinseed, Zebra Mussels, water mites and dragonflies in 2005.

Hilda and John B. Pangman Conservation Reserve

In 2005, the Pangman Reserve was used in studies of Cerulean Warblers, American Redstarts, Golden-winged Warblers, the genetic diversity of birds, Black Rat Snakes, Largemouth Bass, Northern Pike, Bluegill, damselflies, water mites and the isotopic composition of precipitation and surface waters.

In Warner Lake, the Lotek Ecological Observatory was used to monitor the movements of 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.

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, Brown-headed Cowbirds and Song Sparrows in 2005.

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.

Maurice and Wayne Hutchings were 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. The Hutchings have been very cooperative, keeping cattle out of research areas until studies are over for the year. In late summer, they mowed field edges on the northern portion to control weed growth.

Moores Tract

In 2005, the Moores Tract was used in studies of Black Rat Snakes, Spring Peepers, dragonflies and water mites.

Crabbe Property

The Crabbe House has again been a base of operations for study of Brown-headed Cowbirds in 2005. Dr. D. Sherry in studying the behaviour and physiology of cowbirds.

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 barn swallows and invasive species in 2005. Plots with deer fencing were set up in the Quonset field to study the invasiveness of *Silene*.

Ken Young uses the barn for cattle and hay. The open fields were hayed by Ken in 2005.

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

Boston Wildlands

Some visits to the Boston Tract were made in 2005, to increase familiarity with the property and its flora and fauna. An investigation of the "mystery road" crossing the property was initiated in 2005.

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 2005, the islands and mainland property of Queen's Point were used for studies of Black-capped Chickadees, American Robins, Tree Swallows, Barn Swallows, Red-winged Blackbirds, the genetic diversity of birds, Black Rat Snakes, Map Turtles, Spring Peepers, bats, Largemouth Bass, sunfish, Zebra Mussels, phytoplankton, moths, katydid and food webs.

Some repairs were made to the boardwalk to Cow Island.

Further development of the interpretive trail to Cow Island was done in 2005. Karen Mack worked on the outline of an interpretive guide, stops of interest, tree identification and signage. All that remains is to produce the brochure and have the signs made and installed.

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. Bonnie Beresford is Queen's University Veterinarian and Director of University Animal Care. She is available for discussion of animal care issues at beresfor@post.queensu.ca. UACC communications can also be accessed/delivered at UACC@post.queensu.ca or via Tina Burke, Secretary UACC (TB6@post.queensu.ca).

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. This has been done for our small pontoon boat. Because it is used in protected waters, Transport Canada has provided a permit for the small pontoon boat, with a limit of 10 persons plus the operator. Still, a load test proved it barely adequate for even this number. Our large pontoon boat must be retired because certification and operating requirements would be too onerous and restrictive for this size of vessel.

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 2002) - next test in June 2007
- 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 when small numbers of people are present at QUBS

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. The portable fire pump is 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 are committed to providing a safe environment at QUBS.

Renovations and Additions

Operations Centre

With the roof repairs completed in 2004 and the leaking stopped, all of the water-damaged drywall and paint was repaired in the dining room, dishwashing room, the kitchen and front foyer over the winter. The damage was pretty extensive and took some time and care to put right.

The original Formica on the countertops in the servery were lifting apparently because of failure of the adhesive used during fabrication. We were able to get new Formica sheeting to match the original. We removed the old, lifting Formica, cut and fitted new sheets, replacing the countertop under the drink dispensers and the countertop under the small refrigerator, cookie bin and coffeemaker.

At the serving window, the Formica was replaced with a stainless steel countertop made to our specifications by Dowling Sheet Metal (Kingston).

In fall, the wood floors in the Operations Centre were sanded, crack filled, sealed and varnished using Fabulon finish by Lanark Hardwood Flooring (McDonald's Corners). Some of the movements of the floor that we have noted are self-induced. A less than professional installation overall and our use of too much water during regular cleaning had let water infiltrate and warp some areas while opening up gaps in others. Hopefully with the refinishing and a new approach to cleaning up (using as little water as possible) should help preserve the floor.

The two flights of fir stairs at the entryway were once again sanded, crack filled and revarnished.

After the floor finishing work, new baseboards for the servery were fabricated, painted and installed. The new plain profile should make cleanup easier than the ridged originals.

In the bathrooms, the countertops were repaired, painted and all sinks sealed to prevent damage to the lavs from leakage due to spills and splash.

Renovations and Alterations Fund

Under the Dean's Renovations and Alterations Fund, the two oil tanks in the White House and the Manager's House were replaced. These tanks were 35 and 25 years old, respectively. Further, any leak would conduct oil through the floor drains to the margin of the lake.

Although oil tank replacement is not dealt with directly under the Occupational Health and Safety Act, Dan Langham (Director, Queen's Environmental Health and Safety), in an e-mail communique to Frank Phelan, QUBS Manager, wrote: *"I have no problems endorsing this plan, since our mandate extends beyond the scope of the Occupational Health & Safety Act to include issues of environmental protection and compliance with the other safety related legislation that is in effect in the province."*

Due diligence dictated that the tanks should be replaced to minimize the risks. New, double-walled tanks (Roth DWT 1000) now provide an extra measure of safety in the case of a leak. During installation, the oil supply lines were changed to meet current standards. The work was done by Triheat/Anglin's in late summer.

Thank you to the Dean for providing the necessary funds for this work.

Boathouse/Dock Area

After completely revamping the older lab buildings themselves, the walkway into the upper level of the Boathouse was removed and replaced with a cedar walkway and railings. Underneath, the use of steel bridging helped preserve headroom under the walkway. The old wooden steps were removed and new steel steps were installed leading down to the lower Boathouse. At the same time, safety railings alongside the steps and flanking the concrete retaining wall were installed. These changes complete the refurbishing of the older lab buildings.

On the lake side of the Trilab, Robb Mcmanus (Portland) installed a steel catchment with grating to reduce the erosion and runoff down the slope to the waterfront. When the catchment fills with dirt and gravel, we will now be able to dig it out of the catchment and redistribute it on the slope.

To complete the dock reconstruction work, four new finger docks were built of cedar. These new docks are fitted with polyethylene floats (Techstar Series 2 floats) purchased from Dockmaster in Carleton Place. In keeping with an ecologically sound system, these docks enable good access to the boats and water without impacting the lake bottom.

Fencing

The newly-surveyed boundary on the East side of the Chapman Field, between QUBS and the M.F. Watson property was marked with a new cedar post and paige wire fence.

In addition, any rotting or unstable posts along the entrance road to QUBS were replaced and the fencing repaired. This process was greatly aided by the newly-purchased 3-point hitch posthole auger (Bush Hog PHD2101 with a 9" auger).

Cottages

A new water pump and captive air tank was installed at Earl Cottage. A new pumphouse was built under the front deck to house the new equipment.

At Maplewood Cottage, repairs were made to the front deck. Any rotted boards on the seats and top rails were replaced.

A new bunk bed was installed in Maplewood Cottage - small bedroom.

White House

The steps and railings on the lake side of the White House leading down to the path to the Boathouse were replaced with cedar steps and railings in summer.

New bunk beds were purchased and installed in Rooms 2 and 3 of the White House.

A new stair runner for the basement stairs was installed in spring.

In fall, preparations were made for a complete overhaul of the White House Basement Apartment.

Net Building

To improve access to sampling gear, the net building donated by Dr. Don McQueen and previously located in the barnyard behind Hughson's, was relocated to Queen's Point. It is now set up beside the Storage Building. Its contents and the condition of the sampling gear will soon be compiled and assessed.

Storage Building

To prevent the buildup of ice and snow in front of the doors of the storage building (to say nothing of the risk to users from falling snow and ice), snowstop was purchased from Amherst Roofing (Kingston) and installed in fall.

Inside the Storage Building, some storage areas were built for specialized equipment. In addition, several large bins were purchased to provide mouse-proof storage for equipment.

Landscaping

Wooden crib steps filled with stone dust were built into the path past Cabin 8 leading down to Keast Beach to control erosion. On the other side, wooden ties were dug in and stone dust added to the path to help control erosion there.

Jamie Simmons (Chaffey's Lock) agreed to part with an old hay rake. It was brought to QUBS and installed as a decorative element of the circular driveway in front of the Operations Centre.

Necessary repairs were made to the Boardwalk to Cow Island.

Wireless Hubs

To provide wireless service to QUBS, in addition to the LAN (Local Area Network), two wireless ports (Cisco AiroNet 1200s) were added - one in the south upper window of the Operations Centre and one in the north upper window of the upper Brown Lab. These provide decent coverage for wireless computing in the main buildings and some of the outlying cabins.

Brown Lab

New chairs were purchase for the upper Brown Lab Conference Room in summer.

Mattresses

As part of regular replacement, 10 new single bed mattresses were purchased. These replace the worst of the mattresses on site. We plan to replace some each year to keep quality mattresses in place. A new piece of foam replaced the custom mattress in the Shaker.

Tank House

In an effort to upgrade all space under a roof on site, the old Tank House received a lot of attention in fall. The roof margins were replaced and the roof resingled. The end walls were sheeted with plywood on the interior to provide some stabilization. The floor was sheeted over with tongue and groove plywood and subsequently stained. A new door and windows were installed. The wiring was replaced, splitting lighting from outlets. Finally, a new

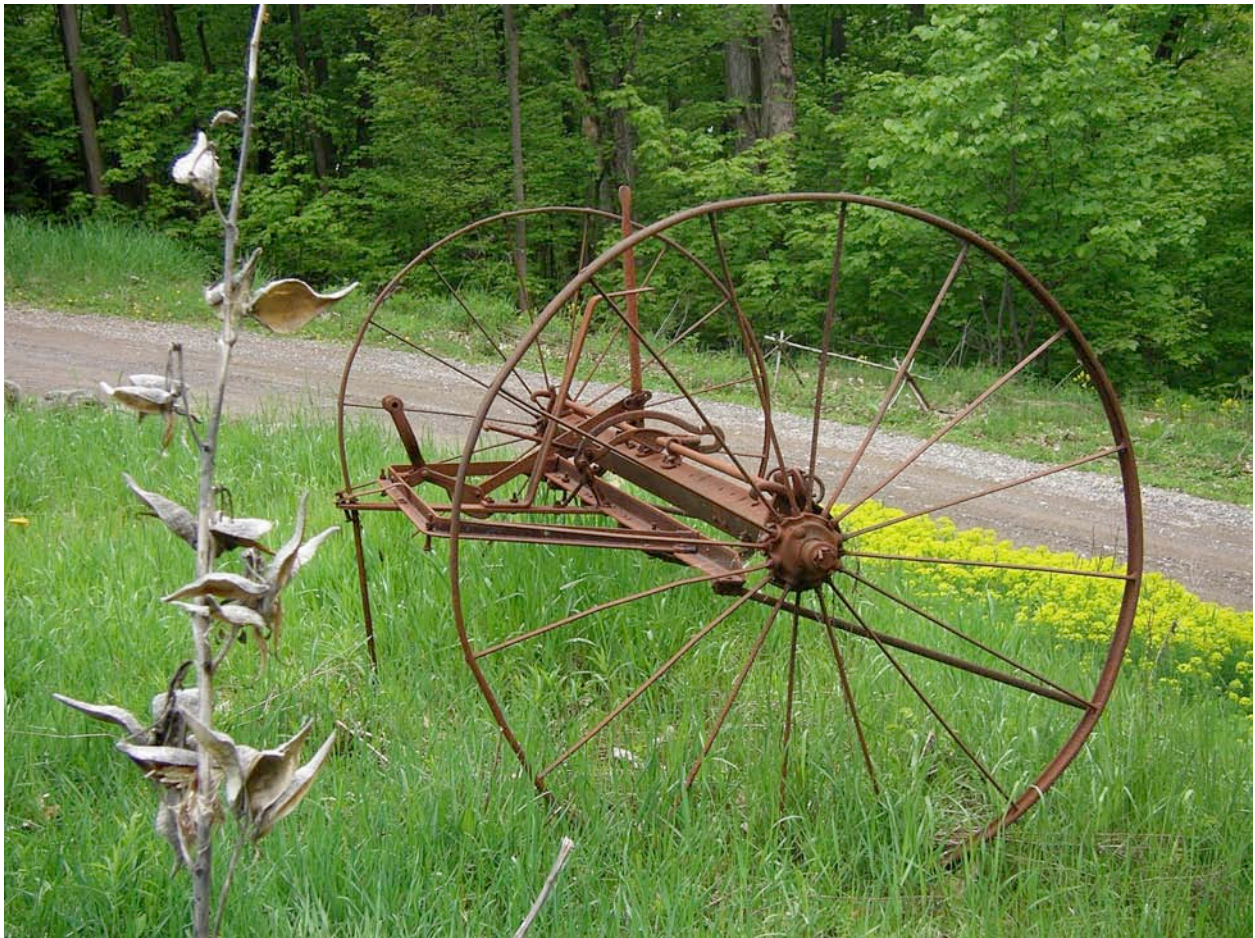
entrance deck was built. Although it has not been decided just what use the building will serve, this renovation will enable almost any kind of use from office to lab.

New Work Truck

Our old green Ford was retired in summer. A new 2005 Chev Silverado 3/4 ton 4x4 pickup was purchased from Taylor's (Kingston). In fall, the truck was equipped with an 8' Arctic Plow and winter tires from Gemmill's (Perth). This is a work truck more matched to our needs than any in the past.

Safety

On recommendation of Queen's Environmental Health and Safety, fall restraint systems were installed on the weather tower on the point and the communications tower atop the hill by the Manager's House. These rail system arrestors, coupled with a four-point safety harness enable climbing the towers in safety.



The old hayrake in front of the Operations Centre - obtained from Jamie Simmons

Table 1: Summary of enrolments in the Ontario Universities Program in Field Biology in 2005 (QUBS courses highlighted)

Toronto	Marine Biology	Huntsman	0	0	2	0	0	0	0	9	1	0	2	1	1	16
Windsor	Great Lakes Field Biology	Windsor	2	0	2	0	0	1	1	0	0	1	3	7	0	17
Toronto	Field Botany	Koffler	0	0	4	0	0	0	1	15	0	0	0	0	0	20
Toronto	Biodiversity of Indochina	Vietnam	0	1	0	0	1	0	1	8	0	0	1	0	0	12
Trent	Ecology of the Kawarthas	Pigeon Lake	0	1	1	0	1	1	0	3	1	1	2	0	1	12
Western	Wetland/Waterbird Ecology	Port Rowan	1	0	1	0	0	0	0	1	0	0	6	0	2	11
Brock	Aquatic Insect Ecology	Algonquin	0	0	1	0	0	0	0	0	0	0	2	0	3	6
Toronto	Arctic Ecosystems	Churchill, Mb	0	0	2	0	0	0	1	11	0	0	1	0	0	15
McMaster	Tropical Ecology	Tanzania	0	0	2	0	0	0	4	1	1	1	0	0	0	9
Trent	Forest Ecosystem Monitoring	Pigeon Lake	0	0	1	0	2	1	0	0	5	1	1	0	0	11
Guelph	Marine Biology/Oceanography	Huntsman	0	0	13	0	0	0	2	0	0	0	0	0	0	15
York	Biology of Bees and Wasps	QUBS	1	0	1	0	1	1	0	0	1	0	0	0	4	9
Waterloo	Marine Mammals & Seabirds	Huntsman	1	1	7	1	0	3	3	1	1	0	0	0	0	18
Guelph	Field Ecology	Algonquin	0	0	13	0	1	0	3	0	0	0	0	0	0	17
Ottawa	Field Ecology	QUBS	0	0	1	0	0	5	2	1	0	0	2	0	0	11
York	Biodiversity and Conservation	Erie, PA	3	0	1	0	0	1	0	1	0	0	1	0	2	9
McMaster	Systematics of Flowering Plants	QUBS	0	0	0	0	5	1	0	0	1	0	1	0	2	10
Guelph	Environmental Biology	Iceland	2	0	18	0	0	1	2	0	0	0	1	1	0	25
Western	Alpine Ecology	Kananaskis, Al	0	1	3	0	2	0	2	1	1	1	5	0	0	16
Toronto/Qu	Aquaculture in Thailand	Thailand	0	0	0	0	1	0	2	0	0	0	1	0	0	4
McMaster	Insect Taxonomy/Ecology	QUBS	0	1	0	0	1	4	1	0	1	1	1	1	1	12
Queen's	Limnology of Stressed Ecosysts	Killarney PP	0	1	2	0	1	0	3	2	1	1	0	1	0	12
Western	Marine Biology	Huntsman	0	0	0	0	1	0	4	2	0	1	8	0	0	16
Waterloo	Terrestrial & Aquatic Biology	Algonquin	0	2	3	0	1	0	1	1	0	5	2	0	1	16
Toronto	Ecology of Small Mammals	Koffler	0	0	1	0	2	3	1	0	0	0	2	0	2	11
Toronto	Tropical Marine Biology	Barbados	0	0	4	0	0	0	0	8	0	1	1	0	1	15

# of students	12	14	101	2	28	45	62	79	15	22	59	12	30	481
# student-weeks	22	27	198	4	47	81	122	157	27	43	106	23	46	903

B=Brock C=Carleton G=Guelph L=Laurentian M=McMaster O=Ottawa Q=Queen's To=Toronto Tr=Trent Wa=Waterloo We=Western Wi=Windsor Y=York

Table 2: Summary of credits earned in the Ontario Universities Program in Field Biology in 2005

	Brock	Carleton	Guelph	Laurentian	McMaster	Ottawa	Queen's	Toronto	Trent	Waterloo	Western	Windsor	York	Total	Total
														Student-Weeks	Half-Course Credits
Total Student-Weeks Not at QUBS	21	20	179	2	38	53	105	153	22	40	92	20	35	780	390
Total Student-Weeks at QUBS	1	7	19	2	9	28	17	4	5	3	14	3	11	123	61.5
Total Student-Weeks in Field Modules	22	27	198	4	47	81	122	157	27	43	106	23	46	903	
Total Half-Course Equivalents in Field Modules	11	13.5	99	2	23.5	40.5	61	78.5	13.5	21.5	53	11.5	23		451.5

13.6% of credits in entire program earned at QUBS in 2005 (22.1 % in 2004; 11.9% in 2003; 13.5% in 2002; 14% in 2001)

13.9% of Queen's credits earned at QUBS in 2005 (40.4% in 2004; 21.3% in 2003; 41% in 2002; 30% in 2001)

Research Conducted at QUBS in 2005 (alphabetical by Principal Investigator)

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.

Brandon Schamp - “Predicting competitive success and invasibility of plants in old fields”
- PhD thesis

This field experiment, which will run for two growing seasons, has been undertaken to determine whether species traits that are normally associated with competitive ability (e.g. species size, seed size) can predict the rate of density dependent mortality for each species in species mixtures vs. monocultures. Vegetation plots were placed in a tilled and cleared section of the ‘New Barn’ field at the Queen’s University Biological Station. These plots, delineated by wooden boxes (40cm X 40 cm) located one metre apart, were surrounded by a fence to discourage herbivores. Each plot was assigned as either a monoculture of one of 17 perennial plant species or a mixture of all of these species. The number of seeds sown into both mixtures and monocultures was set such that each plot would yield the same number of individuals. Mortality rates will be compared in light of species-specific traits to determine which traits are the best predictors of competitive success. The data will also be used to assess whether the variation in the number and density of invading species (those not planted) is affected by variation in either the number, density, or size of planted species in different plots.

Assistants: Jenn Waugh

Elizabeth Thompson - “Components of environmental heterogeneity within plant neighbourhoods” - BSc Hons thesis

We are using old field experimental plots in the ‘New Barn’ Field to test the following question: Do more heterogenous environments cause more species to coexist (higher species richness), or does higher species richness cause environments to be more heterogeneous? We will test the prediction that most of the natural spatial environmental (physical and chemical) variation within a plant neighbourhood is due to: (a) spatial variance in the effects of the plants in causing heterogeneity in the physical environment, either directly (e.g. through resource depletion, allelopathy, placement of decomposing litter), or indirectly through effects of the plants on the non-plant biotic environment (e.g. activity and composition of soil microbes, e.g. mycorrhiza, pathogens); and/or (b) spatial variance in the direct effects of the physical presence of the plants themselves (i.e. in occupying space) (e.g. causing shade; pre-empting a safe site for seed germination).

Assistants: Marina Neytcheva, David Kleiman, Gillian Piggott, Brandon Schamp, Jenn Waugh

David Kleiman - “Why do plants have different sized leaves?” - BSc Hons thesis

A wide range of woody species at QUBS was sampled to investigate whether there is a trade-off between leaf size and leaf number (analagous to the trade-off between seed size and number). We predict that having a large number of leaves (and hence relatively small leaves) spreads out the risk of leaf loss to herbivores over a greater area, and provides a large number of axillary (lateral) meristems (buds), thus allowing greater branching intensity and/or greater ability to replace damaged/lost shoots. Hence, relatively small leaf size may be just the trade-off of selection that favours large number of leaves, or meristems.

Assistants: Elizabeth Thompson, Marina Neytcheva, Gillian Piggott, Brandon Schamp, Jenn Waugh

Marina Neytcheva - “Fitness components in competing annuals” - BSc Hons thesis

This study is designed to test whether more than just plant size variation affects variation in fitness in competing annuals. Seeds of local annual species were collected throughout the summer to be used next year in a greenhouse competition experiment. Annuals are being used because the important fitness estimate of lifetime fecundity can be obtained within a single growing season. For each species we will record seed size, early growth rate in isolation, adult plant size in isolation, germination time in isolation, percent survival under competition, size threshold for seed production in isolation, and fecundity per unit plant size per unit time in isolation. We predict that under competition in mixture, all of the traits related to "time", "survival" and "fecundity" will be at least as important (and possibly more important) than plant "size" traits for predicting between-species fitness variation.

Assistants: Elizabeth Thompson, David Kleiman, Gillian Piggott, Brandon Schamp, Jenn Waugh

Gillian Piggott - “Examining the effect of plant density and resource use efficiency on species colonization” - BSc Hons thesis

There has been a considerable drive to better understand what conditions promote or restrict successful colonization of communities by new or foreign species. While there is some controversy over the role that diversity plays in this, recently, some evidence has suggested that plant density (i.e., number of ramets per unit area) may be a more significant and direct determinant of colonization success. We mapped diversity in ~350 1x1 metre plots in the Cemetery Field at Queen's University Biology Station in the summer of 2005, and chose 25 plots of equally high diversity, and 25 additional plots of equally low diversity. In the fall of 2005 we added seeds from 17 old field species that are locally common, but not resident in the Cemetery Field, to the 50 chosen plots. In the spring of 2006 we will collect soil samples from around these plots, as well as light penetration data for these plots. In the fall of 2006 we will census each of the 50 plots for ramet density, species richness, relative abundance, plot size structure, abundance of flowering individuals, colonization success of introduced species, and biomass

production. From this study, we hope to better understand how elements of the community such as diversity, plant density, resource use efficiency, and water and nutrient use may interact to determine the potential for successful colonization.

Assistants: Elizabeth Thompson, Marina Neytcheva, David Kleiman, Brandon Schamp

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

"Behavioural and Physiological Ecology of Reptiles"

My research program is at the interface of ecology, behaviour, and physiology. All physiological processes are temperature dependent. Thus, since reptiles are ectotherms, variation in their body temperature affects all of their developmental and behavioural processes. Hence, body temperature ultimately has a significant impact on fitness. The general goal of my research program is to understand how temperature affects the ecology of reptiles. Specific interests in this general field are diverse and include: - Determining the effect of thermal quality of the environment on the thermoregulatory strategy and habitat use patterns of reptiles. - Examining the effects of temperature during development on the phenotype and behaviour of neonatal reptiles. - Testing for co-adaptation between the thermoregulatory strategy of a species and the thermal dependency of its performance. - Exploring the causes and consequences of extreme sexual size dimorphism, including the link to thermoregulation.

Because reptiles are, proportionally, the most threatened vertebrate group in Canada, I am also interested in the conservation of this group. I determine the habitat requirements of species listed by COSEWIC and I am interested in the potential impact of global warming on the demography of reptiles.

Assistants: Elad Ben-Ezra, Ariane and Félix Blouin, Grégory Bulté, Marie-Ange Gravel, Jeff Row, Carine Verly, Catherine Verreault

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. Thus far, I have collected blood samples from over 300 hatchlings and their 32 mothers and from more than 200 potential fathers. I also made over 1200 captures of 700 individuals and have tracked 38 turtles.

Assistants: Elad Ben-Ezra, Marie-Ange Gravel, Carine Verly

Marie-Ange Gravel - “Diet specialization in map turtles” - BSc thesis

Sexual size dimorphism may arise from sexual selection where one sex gains a reproductive advantage from being larger, or natural selection such as diet divergence, or both. In the Common Map Turtle (*Graptemys geographica*), females are much larger than males, often exceeding twice their size. Extreme female-biased sexual size dimorphism has been hypothesized to be a result of natural selection for diet divergence. The presence of highly dimorphic trophic structures further supports this. The goal of our study is to test the hypothesis that male and female map turtles specialize on different prey type and size. We assessed prey availability in our study lake (lake Opinicon, Queen’s University Biological Station) to determine if turtles show selection for prey size. We have collected fecal samples of adult males and adult and juvenile females during the months of May and June. Prey size can be reconstructed from mussel septa length and snail opercula length that are passed with the feces. The two sexes appear to be choosing different prey, as well as different prey size. Large females prey mostly on zebra mussels and snails (*Viviparous georgianus*), while juvenile females and males seem to consume smaller snails, small zebra mussels and caddisfly larva (*Trichoptera*). Also prey size seems to increase with body size within each sex.

Assistants: Elad Ben-Ezra, Gabriel Blouin-Demers, Grégory Bulté, Carine Verly

Elad Ben-Ezra – “A test of the thermal coadaptation hypothesis in the common map turtle (*Graptemys geographica*)” – BSc Hons thesis.

According to the thermal coadaptation hypothesis, the preferred body temperature (T_{set}) of ectotherms should match their optimal temperature (T_o) for performance. Moreover, indices of thermoregulation assume that T_{set} and T_o are the same. We tested this prediction and assumption with male common map turtles (*Graptemys geographica*) by determining T_{set} and T_o for swimming speed and righting time. The first goal of this study is to compare T_{set} measured by two methods: a dry thermal gradient and an aquatic basking arena. The second goal is to test the thermal coadaptation hypothesis using both methods of determining T_{set} . Given that map turtles are highly aquatic, we contend that the T_{set} determined in the basking arena (22°C - 32°C) better represents T_o . In the dry gradient, T_{set} (23°C – 27°C) was likely affected by the unnatural environment in which moisture may be a limiting factor. The optimal temperatures for swimming (28.6°C) and righting (31.6°C) were within the T_{set} range determined from the basking arena but not from the dry gradient. Thus, we have provided evidence in support of the thermal coadaptation hypothesis for two locomotory performances and have demonstrated a new, more effective method for determining preferred body temperatures of turtles.

Assistants: Gabriel Blouin-Demers, Grégory Bulté, Marie-Ange Gravel, Carine Verly

Carine Verly - "Does multiple paternity augment with female size in the common map turtle?" - BSc thesis

In general, larger females can produce more and/or bigger offspring. It has also been shown that larger offspring survive better. Therefore, larger female map turtles should be more attractive to males. If males incur non-trivial costs of mating, such as missed opportunities or sperm limitation, they should mate preferentially with larger females. Accordingly, multiple paternity should be more common in larger females. To test this prediction, we captured 34 gravid females spanning the full size range of reproductive females and induced egg laying with oxytocin. We then collected blood samples from > 300 hatchlings for paternity analyses (the number of sires will be deducted from the paternal alleles at 3 microsatellite loci). Results will be compared to other turtle species for which multiple paternity has been assessed, in light of their mating systems.

Publications:

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- Blouin-Demers G, HL Gibbs & PJ Weatherhead. 2005. Genetic evidence for sexual selection in black ratsnakes (*Elaphe obsoleta*). *Animal Behaviour* 69: 225-234.
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- Row JR & G Blouin-Demers. In press. An effective and durable funnel trap for sampling terrestrial herpetofauna. *Herpetological Review*.
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Theses:

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- Edwards, Alana. 2005. Using painted turtles (*Chrysemys picta*) to test the cost benefit model of thermoregulation. MSc thesis. Department of Biology, University of Ottawa, Ottawa, Ontario
- Row, Jeffrey R. 2005. Thermal quality influences thermoregulation, behaviour and habitat selection at multiple spatial scales in eastern milksnakes (*Lampropeltis triangulum*). MSc thesis. Department of Biology, University of Ottawa, Ottawa, Ontario

Dr. Linda Campbell, School of Environmental Studies & Department of Biology,
Queen's University, Kingston, Ontario.

"Lake Opinicon Littoral Food Webs and the Impact of Zebra Mussels"

Lake Opinicon has recently experienced the invasion of zebra mussels in the early 1990's. Extensive studies have been done on the biology and ecology of bluegill and

pumpkinseed in Lake Opinicon in the 1970's, but it is unknown how the zebra mussels have affected the dietary habits of those "sunfish". It is possible to gauge modern food web structure and the role of invasive species in lakes using stable nitrogen and carbon isotope tracers and stomach content analyses. How to compare the today's food web to historical food web structure before the invasive species were introduced? In this case, long-term fish archives become an important resource, as archived fish can be sub-sampled, and the subsamples analyzed for stable isotopes. Those archived samples can then be compared to modern samples to determine shifts in food web structure over time due to invasive species.

We collected zebra mussel and phytoplankton samples on the south side of Cow Island to determine biweekly variation in stable isotope values. We also collected littoral fish and invertebrate samples by seining, fish trapping and angling in Birch Bay and by Cow Island.

A complementary sampling program was undertaken at the Royal Museum of Ontario, Canadian Museum of Nature and University of Michigan Museum of Zoology to collect tissue samples of Lake Opinicon fish collected in 1970's.

We will compare stomach content data and archived fish stable isotopes from the 1970's with our contemporary samples from the summer of 2005 to determine the extent of dietary shift and food web changes due to the invasion of zebra mussels.

Honours Biology undergraduate thesis: Carolyn Glass

Summer students: Winnie Chan and Aurora McAllister

Volunteer assistants: Chris Pons and Greg Pons

Dr. Steven Cooke, Department of Biology and Institute of Environmental Science, Carleton University, Ottawa, Canada.

"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 the physiological correlates of

reproduction and fitness in centrarchids, and understanding the factors influencing the spatial ecology of fish.

QUBS Collaborators: Dr. Cory Suski, Dr. George Niezgoda, Dr. Bruce Tufts, Dr. Patrick Weatherhead, Dr. Roly Tinline, Dr. David Philipp, Kyle Hanson, and Caleb Hasler.

Publications:

- Cooke, S.J., B.L. Barthel, C.D. Suski, M.J. Siepkner, and D.P. Philipp. 2005. Influence of circle hook size on hooking efficiency, injury, and size selectivity of bluegill with comments on circle hook conservation benefits in recreational fisheries. *North American Journal of Fisheries Management*. 25:211-219.
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- Cooke, S.J., D.P. Philipp, D.H. Wahl, and P.J. Weatherhead. In Press. Parental care energetics of six syntopic centrarchid fishes. *Oecologia*
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- Cooke, S.J., and C.D. Suski. 2005. Do we need species-specific guidelines for catch-and-release recreational angling to conserve diverse fishery resources? *Biodiversity and Conservation*. 14:1195-1209.
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- Wikelski M., and S.J. Cooke. 2006. Conservation physiology. *Trends in Ecology and Evolution* (Invited Contribution – Highlighted on Issue Cover). 21:38-46.

Drs. Brian Cumming and John Smol - PEARL, Department of Biology, Queen's University

"Limnology"

Kyle Gervais - "Assessment of the impacts of Zebra Mussels on the seasonality of phytoplankton in a Lake Opinicon (Ontario, Canada): a comparison between pre- and post-invasion assemblages" - B.Sc. thesis

For Kyle's thesis, data on changes in algal assemblages were collected every two weeks from May through December. Changes in algal assemblages were compared to records of algal seasonality collected by Mike Agbeti between 1989-1991. Changes in water chemistry and implications to biogeochemical cycling were also assessed. Seasonality was also assessed in nearby Upper Rock Lake, a lake that was not colonized by Zebra Mussels, to help control for other possible changes that could influence primary producers (e.g. climate). This data will also provide the necessary background community data in which to assess environmental changes in the future, that may be attributable a changing climate.

Crystal Lai - "Assessment of the impacts of Zebra Mussels the seasonality of zooplankton in Lake Opinicon (Ontario, Canada): a comparison between pre- and post-invasion assemblages" - B.Sc. thesis

For Crystal's thesis, data on changes in zooplankton (ZP) assemblages were collected every two weeks from May through December. Changes in ZP assemblages were compared to records of ZP seasonality analysed by Christine Watters between 1989-1991, prior to the successful invasion of Zebra Mussels into Lake Opinicon. Changes in the depth distribution of zooplankton throughout the year were also assessed, as were the veligers of Zebra Mussels. Seasonality and the depth distributions of zooplankton was also assessed in nearby Upper Rock Lake, a lake that was not colonized by Zebra Mussels, to help control for other possible changes that could influence primary producers (e.g. climate). This data will also provide the necessary background community data in which to assess environmental changes in the future, that may be attributable a changing climate.

Dr. John Epifanio, University of Illinois & Illinois Natural History Survey

"Fidelity to Colony Sites: do parental male bluegill return to previously used nesting locations?"

For the past two summers, we examined the likelihood for iteroparous, nest-building males to return to historical spawning locations within and between years. To address this question, we surveyed and marked all spawning parental males in Long Lake with a combination of physical fin clips that were unique to location and date. In addition, a subset of males and colonies received individual-specific marks in the form of PIT tags to provide additional information on location and association with individual males. By swimming the entire lake on alternate days, we marked greater than 95% of spawning males in each year.

In all, approximately 25% of nesting males were recaptured during a subsequent spawning event (including in the subsequent year). Of these, greater than 90% recaptured returned to the approximate area to spawn in proximal or nearby (less than 25 meters) colony location. Of those that "wandered", the vast majority spawned within 100 meters of the initial location of capture. These results are consistent with an hypothesis that males exhibit a high

degree of fidelity to spawning location. While we could not exclude the possibility that males merely exhibit a small home range, future collections during the winter or other non-spawning times will provide some indication as to whether active return is occurring. Moreover, future experiments to manipulate reproductive success will help explain whether this high rate of fidelity is consistent with hypotheses associating spawning site location with reproductive fitness.

Assistants: Julie Claussen, David Philipp, Aaron Schults, Olivia Dorothy

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

"Evolutionary Ecology and Ecological Parasitology"

This year we had two field and lab projects done at QUBS. My own research involved finishing projects on frog susceptibility to bacterial infections, and seasonal changes in amphipod sex ratios (only the theory was done at QUBS with field work in NS). QUBS also remained a collection site for trematode parasites of frogs.

Tonia Robb - Variation in resistance to parasitism" - Ph.D. Thesis

This summer, Tonia redid an experiment pertaining to her general thesis topic of variation in resistance to parasites by insect hosts. In this study, she examined if there were sex differences in fitness costs (survivorship) when an immune response is induced under conditions of food limitation for the damselfly *Enallagma boreale*. She had performed this experiment last year, but recently expanded the project to include comparisons among age groups. She also examined gender differences in parasitism by mites for *Lestes* damselflies and explored weather-related effects on host and mite success. Finally, Tonia initiated a new study on trade-offs between egg tanning and immune responses in *Enallagma ebrium* damselflies. We know a fair amount of the natural history of these damselflies which enables our formulating realistic alternative hypotheses.

Assistant: Jamie MacDougall

Pam Rutherford – "Do anti-enemy responses of damselfly larvae depend on order of presentation of threats" - PDF research co-supervised with Dr. R. L. Baker, Univ. Toronto

One curious finding of earlier work by RL Baker and BP Smith was that damselfly larvae appear to groom in response to contact by larval mites, even while in presence of predatory fish. In the presence of fish predators only, the damselflies show quite characteristic anti-predator responses which entail remaining motionless (i.e. not grooming or performing other obvious behaviors). Pam initiated studies to determine if order of presentation of threats influenced the likelihood of anti-enemy responses being expressed, even if those responses proved deleterious in current contexts (e.g., another enemy arriving).

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- Dare O, Rutherford PL, Forbes MR. Rearing density and susceptibility of *Rana pipiens* metamorphs to cercariae of a digenetic trematode. *Journal of Parasitology*, in press
- McGuffin MA, Baker RL, Forbes MR. Ovipositing *Enallagma* damselflies do not respond to chemical cues of predatory fish. *Journal of Insect Behavior*, in press.
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Dr. James H. Fullard, University of Toronto at Mississauga

"Insect Auditory Ecology and Neuroethology"

Once again we ventured into the mysterious world of how sensory systems enhance and limit the survival ability of insects and the bats that prey upon them. Our summer was somewhat abbreviated this year due to my late arrival from a research sabbatical in the South Pacific laden with ciguatera fish poisoning. The bat/moth flight room was back in action this summer with new experiments with katydids (terHofstede) and the high-speed video set-up continued with more studies of moth flight under acoustic stimuli (Muma).

Hannah ter Hofstede – “*Myotis septentrionalis*: A Katydid Predator” - PhD thesis

Katydid (Tettigoniidae) are known for their loud calling songs, produced by males to attract females. These conspicuous signals are easy to localize, which means they are excellent for mate attraction, but also risky due to eavesdropping predators such as gleaner bats. *Neoconocephalus ensiger*, a katydid found throughout North-eastern North America, demonstrates song pausing and cessation when exposed to ultrasound while singing (Faure and Hoy 2000 *J Comp Physiol A* 186:129-142). We conducted fieldwork at the Queen's University Biology Station (QUBS) during July and August 2005 to determine the bat species exerting selection pressure on these katydids. *Myotis septentrionalis*, a gleaner, became the prime suspect. In a large outdoor flight enclosure, wild-caught *M. septentrionalis* readily landed on a speaker broadcasting the calling song of *N. ensiger* and attacked live individuals singing in grass (their

natural habitat). *M. septentrionalis* demonstrated stereotyped prey-handling behaviour (n = 8): katydids were eaten in a head-upright posture by grasping a vertical surface with thumbs and hind feet, forming a pouch with their tail membrane over which they ate. Katydids were consumed from the anterior to posterior end, and hard parts (such as mouthparts, wings and legs) were allowed to fall off into this pouch. The bats would then search through these pieces to look for meaty bits that were missed before allowing the cullings to fall to the ground. The fact that these hard parts were not consumed could explain why katydids have not been identified in diet (fecal) analyses for these bats. Fecal analysis on 6 bats that had consumed only katydids revealed no wing segments, and very few identifiable parts. Fecal analysis on 35 wild-caught bats revealed 1 katydid mouthpart. Future work will explore the sensory sensitivity of *N. ensiger* to gleaning attacks of known intensity using neurophysiological methods and include comparisons with other local katydid species.

Assistant: Maria Naccarato

Kit Muma and James Fullard – Ithaca College and University of Toronto, Mississauga

"High resolution video analysis of moth anti-bat avoidance and the underlying neural control of these flight behaviors"

I study the evolution of sensory adaptations of animals. For the past five years I have directed my interests to neuroethology which is the combination of studies in animal behavior and the underlying neurophysiological mechanisms responsible for behavior. In particular, I am fascinated by the evolution of ultrasonic hearing in insects and the coevolution between bats and their insect prey. This type of research has implications in a broad range of fields from pest management (Fullard, Muma and Dawson 2003) to the development of subminiature microphones and even hearing aids (see work by Robert and Hoy 1998).

The goal of the experiments in the current study is to determine the timing of behavioral flight responses of moths to ultrasonic pulses and correlate these motor responses to the exact sensory pathways of the auditory system. I videotaped moths in stationary flight using an infra-red high-speed video camera. The moth was transferred to an auditory neurophysiology chamber where we monitored the receptor neurons of its tympanic nerve while its ears were stimulated by the identical sounds that activated the flight behaviors. During the summer of 2005 I worked on the frame-by-frame analysis of sequences of the flight patterns to correlate these with the auditory responses of the organisms as recorded directly from their tympanic nerves. This will provide an empirical demonstration of how simple ears directly govern specific behaviors.

Assistant: Maria Naccarato

Publications:

Fullard, J. H., Guignion, C., and Ratcliffe, J. M. 2005. Sensory ecology of predator-prey interactions: responses of the AN2 interneuron in the field cricket, *Teleogryllus oceanicus* to the echolocation calls of sympatric bats. *Journal of Comparative Physiology A* 191:605 –618.

Ratcliffe, J.W. and Fullard, J.H. 2005. The adaptive function of tiger moth clicks against echolocating bats: an experimental and synthetic approach. *Journal of Experimental Biology* 208: 4689-4698

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

Kate Buckeridge - "Snow depth and nitrogen deposition effects on the soil microbial community and nitrogen cycling" – PhD thesis

Nitrification and denitrification play important roles in regulating nitrogen pools in terrestrial ecosystems, and in the production of the greenhouse gas nitrous oxide. There are a few environmental controls that are known to determine nitrification and denitrification process rates, such as temperature and nitrogen availability. However, it has also been shown recently that the microbial community present in the soil may influence the nature of the response to these environmental controls. It is unknown how these different communities will respond to changes in climate or to changes in rates of nitrogen deposition. Predicted changes in climate see the greatest temperature increase in winter, as well as an enhanced snowfall, both of which promote warmer winter soil temperatures. We hypothesize that increased soil temperatures and predicted increases in nitrogen deposition will also change soil microbial communities, and thus modify the expected change in nitrification and denitrification rates with climate change.

To test this hypothesis, we have erected snow fences (to enhance snow depth) and added nitrogen fertilizer in a factorial experiment in Stokes field (located on the western edge of the QUBS property that is accessible from Opinicon Road. We will sample soil regularly throughout the year to measure nitrogen pools and nitrogen cycling process rates, and we will also determine the functional and molecular structure of the soil microbial community. Extra emphasis will be placed at the winter-spring transition, as spring thaw is a time of enhanced nitrification and denitrification.

Dr. Jason Jones, Dept of Biology, Vassar College, Poughkeepsie, NY

"Minimum Area Requirements in the Cerulean Warbler."

In collaboration with Dr. Raleigh Robertson, I continued the long-term research (dating to 1994) into the life history and ecology of the Cerulean Warbler (*Dendroica cerulea*) at and around QUBS. During the 2005 field season, we continued large-scale survey work started in 2004 in an attempt to quantify the minimum size of forest patch required by Cerulean Warblers for successful reproduction in eastern Ontario. Over 120 forest plots were surveyed in Frontenac and Leeds/Grenville counties. Unfortunately, we detected Ceruleans in so few forest patches that we were unable to obtain useful metrics of patch occupancy. In general, Cerulean Warblers are far less common and far more restricted in their distribution than previously believed, further emphasizing their conservation status in Ontario and Canada.

Assistants: Rachel Barnett, Eliot Miller, Ashley Spenceley, Lindsay Spenceley, Jessica Waite

Publications:

- Barg, J. J., D. M. Aiama, J. Jones, and R. J. Robertson. In press. Within the territory: habitat use and micro-habitat selection by male Cerulean Warblers. *Auk*.
- Barg, J. J., J. Jones, M. K. Girvan, and R. J. Robertson. Within-pair interactions and parental behavior of Cerulean Warblers breeding in eastern Ontario. *Wilson Bulletin* (accepted pending approval of minor revisions).
- Barg, J. J., J. Jones, and R. J. Robertson. 2005. Describing breeding territories of migratory passerines: suggestions for sampling, choice of estimator, and delineation of core areas. *Journal of Animal Ecology* 74:139-149.
- Gibb, C. E., J. Jones, M. K. Girvan, J. J. Barg, and R. J. Robertson. 2005. Geographic variation in prevalence and parasitemia with *Haemoproteus paruli* in the cerulean warbler (*Dendroica cerulea*). *Canadian Journal of Zoology* 86:626-629.
- Jones, J., C. E. Gibb, S. C. Millard, J. J. Barg, M. K. Girvan, M. L. Veit, V. L. Friesen, and R. J. Robertson. 2005. Multiple selection pressures generate adherence to Bergmann's Rule in a Neotropical migrant songbird. *Journal of Biogeography* 32:1827-1833.
- Jones, J., J. J. Barg, T. S. Sillett, M. L. Veit, and R. J. Robertson. 2004. Survival and population growth rates of Cerulean Warblers breeding in Ontario, Canada. *Auk* 121:15-22.
- Jones, J., W. J. McLeish, and R. J. Robertson. 2004. Predicting the effects of Cerulean Warbler management on eastern Ontario bird species. *Canadian Field-Naturalist* 118:229-234.

Dr. Kurt Kyser, Department of Geological Sciences & Geological Engineering, Queen's University.

"Changes in the Isotopic Composition of Precipitation of Groundwater and their Relation to the Isotopic Composition of Bird Feathers"

During the period from June to October 2005, we collected precipitation from samplers placed in various micro-environments over the portion of QUBS used to study the migration and breeding habits of American redstarts. Precipitation samples were collected every two weeks and there were ten stations. In addition, samples of lake and spring waters were collected from the area to reflect waters at surface as well as seeping from underground aquifers. The purpose of this study was to evaluate the change in the hydrogen isotopic composition (expressed as dD values) of water over the breeding season of American redstarts in this area and compare the variations with both time and space to see if the dD values in feathers from birds moulted on the breeding grounds could be explained by variations due to micro-environments.

The hydrogen and oxygen isotopic compositions of precipitation and surface waters indicate a change from June to September wherein both values increase due to an increase in temperature and evaporation. The total variation observed both temporally and spatially in dD values was 12 per mil. The range observed in birds known to moult in the QUBS area is 15 per mil. Consequently, it is likely that the variations observed in feathers of returning birds to QUBS can be explained entirely by the variation in micro-climates in the study area since the feathers were moulted at QUBS in the preceding breeding season. The results further indicate that birds with dD values in their feathers outside the normal QUBS range most likely reflect birds that moulted in very different areas during the previous year.

Assistants: Richard Zavitz and Katie Shorter

Dr. Kurt Kyser and Dr. Len Tsuji - Department of Geology, Queen's University and Department of Environment and Resource Studies, University of Waterloo, Waterloo, Ontario

Jim Karagatzides, “Effects of soil acidification and bismuth shotshell pellets on southern Ontario ecosystems” - Dept of Geography, Queen’s University, Kingston, Ontario.

Bismuth shotshell has been used as a non-toxic alternative to lead but the environmental fate of bismuth has not been studied adequately. We undertake a series of studies with the overarching objective to determine if bismuth shotshell pellets are mobilized in forest and wetland ecosystems, particularly under chronic acidic deposition. We established 24 plots in each of a sugar maple forest (Hughson tract, adjacent to the Stokes field) and sedge marsh (Osprey Marsh) in 1999 and assigned plots to one of four treatments: soil acidification (annual applications of ammonium sulphate fertilizer), bismuth pellets, acidification + bismuth pellets, or no treatment. The results provide information for policy formulation to maintain sustainable environments, as it is not logical to replace one toxin (lead) with another toxic metal (bismuth) unless it can be shown conclusively that bismuth is benign for wildlife, humans and the environment.

Collaborators: Dr. Kurt Kyser (Geological Sciences and Geological Engineering, Queen’s University) and Dr. Len Tsuji (Environment and Resource Studies, University of Waterloo).

Nathan S. C. Fahey – “The use of science in environmental policy making and the implications for health: A case study of bismuth shotshells” - MSc thesis, Environment and Resource Studies, University of Waterloo, Waterloo.

Scientific information is required to make environmental policy that will enhance and protect the health of ecosystems. Using a case study approach, this thesis investigates the Canadian Wildlife Service’s attempts to achieve its mandate of conserving migratory birds while approving bismuth as an alternative to lead that was shown to cause poisoning of birds. This case study serves as an example of the tension between limited or ambiguous scientific information and urgent decisions. The chosen policy alternative to the use of lead shot was the approval of bismuth shot as a non-toxic substitute in 1997 and banning the use of lead shot nationwide in 1999. This decision to approve bismuth shot was based upon a few studies that were interpreted in a way that made it appear benign when compared to lead. This thesis examines the implications of this decision by conducting a comprehensive literature review of bismuth’s interactions with soil, vegetation, and animals, with some medical information on humans to put findings into an anthropocentric context. Also, analysis has been carried out on the results of a four-year study on bismuth in a wetland site near Kingston, Ontario, Canada. Finally, a ‘post-normal perspective’ exploration of the Canadian Wildlife Service revealed that decisions could be harmful to both human and environmental health if the values and knowledge of stakeholders are not taken into account and if uncertainties are overlooked.

Key findings generated by the literature review were potential chronic impacts to the neurological and reproductive health of animals exposed to bismuth shot. In turn, bismuth-contaminated meat may be a source of bismuth for humans and therefore guidelines for consumption should be investigated. Also, soil and vegetation has also been shown to accumulate bismuth, but it is unknown if it accumulates to toxic levels. The wetland study helped to address the literature gap of bismuth's fate in the environment. The mean concentration of bismuth in the soil after four years was 6.40 $\mu\text{g/g}$, which was significantly higher than the control soil mean of 0.42 $\mu\text{g/g}$. Ultimately, a 'post-normal perspective' offers three main tools for decision makers faced with urgent issues and uncertain facts. Namely, extended peer communities, acknowledgement and demonstration of uncertainty, and making values explicit.

Supervisor: Dr. Leonard Tsuji, Environment and Resource Studies, University of Waterloo.

Jim Karagatzides - "Dendrochemical evidence for mobilization of bismuth, tin and lead from bismuth shotshell pellets in acidified soils of southeastern Ontario, Canada" –
Dept of Geography, Queen's University.

Bismuth shotshell has been used as a non-toxic alternative to lead but the environmental fate of bismuth has not been studied adequately. In an upland hardwood forest in south-eastern Ontario, Canada, soil beneath mature sugar, red maple and bitternut hickory was experimentally manipulated from 1999-2003 with bismuth pellets and ammonium sulphate, or left untreated to serve as a control. Soil pH in acidified plots decreased by 1.0 compared to an increase of 0.7 measured for soil from non-acidified plots. Although soil bismuth and tin were below 0.1 $\mu\text{g g}^{-1}$ across treatments, sugar maple and hickory receiving bismuth pellets and acidification had elevated bismuth, tin and lead in sapwood compared to control trees, indicating that soil acidification can mobilize metals from bismuth pellets into the forest biogeochemical cycle within a 4-year period.

Collaborators: Dr. Kurt Kyser (Geological Sciences and Geological Engineering, Queen's University), Lisamaria Akesson (Geological Sciences, Queen's University), Nathan S.C. Fahey (Environment and Resource Studies, University of Waterloo), and Dr. Len Tsuji (Environment and Resource Studies, University of Waterloo).

Dr. Jan Liffjeld, University of Oslo, Norway

"Assessment of Genetic Diversity in North American birds"

As a project of the Natural History Museum at the University of Oslo, a DNA database is being developed to assess levels of genetic diversity in different avifaunas around the world. By extensive mist-netting in various habitats around QUBS, especially at the brook on Lindsay Lake Road, and in Curtis Marsh near QUBS, Frode Jacobsen was able to add 511 samples of 51 species to this collection. Collections were done under CWS scientific permit CA0155, QUACC protocol Robertson 2005-014-OR, and CWS banding permit 10302.

Assistant: Frode Jacobsen

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

“Causes and Consequences of Population Genetic Structure in Songbirds”

In 2005 my lab launched a long term study of sexual selection, population connectivity and disease resistance in song sparrows breeding at the Bracken property. Activities included colour banding, recording song, making morphological and haematological measurements, monitoring nests, and collecting blood samples for studies of parentage, individual- and population-level genetic variability, and a pilot survey of variation at the major histocompatibility complex (MHC).

Two honours thesis advisees conducted their field research at QUBS. Summer NSERC student Megan Barclay investigated hatchling sex ratios produced by female song sparrows in varying condition (determined by haematological traits such as heterophil:lymphocyte ratios and blood-borne parasite load, and morphological traits such as body symmetry and wing loading). Preliminary results suggest that females in better condition produced a higher proportion of sons, as predicted by parental investment and sex ratio theory. Cassandra Hoggard examined the relationship between individual genetic variability (microsatellite heterozygosity) and the song repertoire size of male song sparrows. If relatively heterozygous individuals possess larger song repertoires, this will provide important information on how sexual selection contributes to the maintenance of genetic variation in natural populations.

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

“The Ecology and Evolution of Communication Networks and Mating Strategies in Temperate Birds”

In January 2005 I joined the faculty at the University of Windsor and began a research program exploring the behavioural ecology of temperate versus tropical songbirds. My students and I focus on vocal communication in nonmigratory songbirds and the influence of group-living on the singing behaviour and mating strategies of genetically promiscuous birds. At QUBS, we are commencing an exciting study of black-capped chickadees in collaboration with Laurene Ratcliffe and her students at Queen’s University. In 2005, we began a very ambitious project which uses multiple microphones to record multiple black-capped chickadees simultaneously. This Acoustic Location System allows us to triangulate the position of animals based on the sounds they produce. During late April and early May, we recorded from five different areas of the QUBS property and adjacent lands.

Acknowledgments: NSERC, University of Windsor, Queen's Biological Communication Center

Lauren Reed - "Countersinging contests in songbirds: Investigating communication networks using an Acoustic Location System" MSc Thesis

For my Master's research I am using an Acoustic Location System (ALS) to evaluate countersinging contests in black-capped chickadees. I will use an ALS to record entire networks of breeding male chickadees and evaluate how the singing behaviour of territorial males is influenced by the songs of surrounding individuals. An ALS will allow me to describe birds' movement patterns and the occurrence of frequency-matching, overlapping, and escalation during naturally occurring song contests.

Publications:

Doucet SM, Mennill DJ, Montgomerie R, Boag PT & Ratcliffe LM (2005) Achromatic plumage reflectance predicts reproductive success in male black-capped chickadees. *Behavioral Ecology* 16:218-222.

Schubert KA, Mennill DJ, Ramsay SM, Otter KA, Boag PT & Ratcliffe LM (2006) Variation in social rank acquisition influences lifetime reproductive success in black-capped chickadees. *Biological Journal of the Linnean Society*. In press.

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

"Sexual Selection on Colours, Songs and Sperm"

In 2005, my undergraduate thesis students worked with Dan Mennill (Ann MacKellar) and Mary Stapleton (Ros Dakin) on projects that they are currently writing up for their BSc honours theses. Ann worked with Dan on his song array project on chickadees, at the same time collecting data on robin singing behaviour, as a follow to some work we did at QUBS on robins about 15 years ago. Using the song array data, Ann asked whether male robins sing different songs to different neighbours, whether males are more likely to sing alone or when another male is singing nearby, and whether song repertoires have changed over the past 15 years. Ros measured the plumage colours of known pairs of tree swallows to determine whether there is evidence of assortative mating by colour in this species, and whether colour correlates with aspects of an individual's quality and reproductive success.

With Drs. Jim Austin (Univ Florida) and Steve Loughheed (Queen's), I also continued work on intraspecific variation in sperm morphology and behaviour in spring peepers (*Pseudacris crucifer*), and a comparative analysis of sperm evolution in North American frogs. Both Ros Dakin and Jason Clarke assisted with this field work early in the spring.

Publications

Burness G, Moyes C, Montgomerie R. 2005 Motility, ATP levels and metabolic enzyme activity of sperm from bluegill (*Lepomis macrochirus*). *Comparative Biochemistry and Physiology, Part A* 140:11– 17

Doucet S, Mennill DJ, Montgomerie R, Boag PT, Ratcliffe LM. 2005. Achromatic plumage reflectance predicts reproductive success in male black-capped chickadees. *Behavioral Ecology* 16:218-222

Schulte-Hostedde AI, Burness G. 2005 Fertilization dynamics of sperm from different male mating tactics in bluegill (*Lepomis macrochirus*). Canadian Journal of Zoology 83:1638-1642

Field Assistants: Roslyn Dakin, Ann MacKellar, Jason Clarke

Dr. Chris Moyes, Dept of Biology, Queen's University

"Evolutionary and Environmental Physiology of Centrarchid Fish"

Large animals consume more oxygen than small animals, but in most species studied to date, the difference is not quite as you might expect based on size differences alone. For example, in two animals that differ in size by 10-fold typically differ in total metabolic rate by about 7-fold. Put another way, the larger animal shows a 30% reduction in mass-specific metabolic rate – a pattern that is described as negative allometric scaling. Superimposed on the patterns of allometric scaling of metabolic rate are differences in metabolic enzymes. Like mass-specific metabolic rate, oxidative enzymes scale negatively with body size. Intriguingly, mass-specific activities of glycolytic enzymes demonstrate positive scaling. Though allometric scaling of metabolism was first shown more than 100 years ago, it remains the topic of considerable debate in biology, with vigorous arguments about the best statistical description of data sets, the influence of phylogeny, and the underlying genetic basis for the patterns in metabolism and metabolic enzymes.

In this study, we explored the influence of body size on whole animal metabolic rate, muscle enzyme activities, and the underlying patterns of mRNA for these enzymes in an effort to explain the genetic basis of the enzymatic relationships. Fish in general are useful because of their muscle fiber type homogeneity. We compared the patterns in four species of centrarchid fish were caught locally: largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), pumpkinseed (*Lepomis gibbosus*) and bluegill (*Lepomis macrochirus*). By studying two pairs of sister species of fish, we could assess the regulatory basis of both intra-specific and inter-specific variation in relation to body size, as well as gain insight into the evolutionary constraints within lineages.

Assistants: Rhiannon Davies and Kate Zimmerman

Publications:

Burness GP, S Casselman, A Schulte-Hostedde, CD Moyes & RM Montgomerie. 2004. Sperm swimming speed and energetics vary with sperm competition risk in bluegill (*Lepomis macrochirus*). Behav. Ecol. Sociobiol. 56, 65-70.

Burness, G, CD Moyes & R Montgomerie. 2005. ATP levels, motility and metabolic enzyme activity in sperm from bluegill (*Lepomis macrochirus*) with alternative reproductive tactics, Comp. Biochem. Physiol. 140A: 11-17.

Dr. Bryan D. Neff, Department of Biology, University of Western Ontario, London, Ontario
and Dr. Rosemary Knapp, Department of Zoology, University of Oklahoma,
 Norman, Oklahoma

"Mating Systems in Fish"

During the summer of 2005, Rosemary Knapp and I continued our collaboration that investigates the endocrinology of life histories and parental care in bluegill sunfish (*Lepomis macrochirus*).

Assistants: Beth Clare, Karrienne DeBaeremaeker

Tim Hain - "The evolution of kin recognition in promiscuous fish species" - PhD thesis

In the summer of 2005, Tim investigated the kin recognition abilities of bluegill sunfish larvae sired by males of alternative life histories. The bluegill sunfish provides a unique opportunity to test the theory that multiple-mating drives the evolution of kin recognition. While larvae sired by parasitic 'cuckolder' males are mostly unrelated to nestmates, nest-tending 'parental' males are highly related to nestmates. Thus, cuckolder-sired larvae must recognize kin to gain kin selective benefits, whereas parental-sired larvae can benefit by assisting nestmates at random.

Assistants: Nicholas Sweet, Joy Marcus

Publications:

- Magee, SE, BD Neff and R Knapp. 2006. Circulating concentrations of androgens and cortisol in relation to breeding behaviour in parental male bluegill sunfish, *Lepomis macrochirus*. Hormones and Behavior, in the press.
- Cargnelli, LM and BD Neff. 2006. Condition-dependent nesting in bluegill sunfish (*Lepomis macrochirus*). Journal of Animal Ecology, in the press.
- Stoltz, JA and BD Neff. 2006. Male size and mating tactic influence proximity to females during sperm competition in bluegill sunfish. Behavioral Ecology and Sociobiology, in the press.
- Neff, BD and PW Sherman. 2005. In vitro fertilization reveals offspring recognition via self-referencing in a fish with paternal care and cuckoldry. Ethology 111:425-438.
- Neff, BD and LM Cargnelli. 2004. Relationships between condition factors, parasite load and paternity in bluegill sunfish, *Lepomis macrochirus*. Environmental Biology of Fishes 71:297-304.
- Neff, BD, LM Cargnelli and IM Côté. 2004. Solitary nesting as an alternative breeding tactic in colonial nesting bluegill sunfish (*Lepomis macrochirus*). Behavioral Ecology and Sociobiology 56:381-387.
- Neff, BD. 2004. Increased performance of offspring sired by parasitic males in bluegill sunfish. Behavioral Ecology 15:327-331.

Dr. Ryan Norris, Center for Applied Conservation Research, Department of Forest Sciences, University of British Columbia, Vancouver, BC

“Long-term Population Dynamics of a Neotropical-Nearctic Migratory Songbird”

In collaboration with Dr. Laurene Ratcliffe (Queen’s), Dr. Peter Marra (Smithsonian), we continued our long-term research on American redstarts, a small long-distance migratory songbird that breeds in North America and winters in the Caribbean and Central America. The overall goal of this research, now in its fifth year, is to understand the factors that influence population dynamics in migratory songbirds. We use standardized methods to measure arrival date, capture and mark individuals, measure habitat quality used on the previous season on the tropical wintering grounds (via stable-carbon isotopes), monitor breeding condition, and record reproductive success. In addition to estimating annual reproduction and survival, in 2005 we examined variation in molting latitude between individuals and between feather types within individuals. Led by Matthew Ruedink (Ratcliffe Lab, Queen’s), we sampled a variety of feathers from marked birds that were known to have bred at our study site the previous year. Using stable-hydrogen isotopes, we will examine which feathers were molted on the breeding grounds prior to migration and which were molted during migration.

Field Assistants: Jenna Dixon, Department of Sociology, University of Guelph, Amy Newman, Department of Psychology, University of British Columbia

Publications:

Norris, D.R. 2005. Carry-over effects and habitat quality in migratory animals. *Oikos* 109: 178-186.

Norris, D.R., Marra, P.P., Kyser, T.K. & Ratcliffe, L.M. 2005. Tracking habitat use in a long-distance migratory bird using stable-carbon isotopes in blood. *Journal of Avian Biology* 36: 164-170.

Norris, D.R. & Taylor, C.M. 2006 Predicting the consequences of carry-over effects in migratory animals. *Biology Letters* 2: 148-151.

Dr. David Philipp, Illinois Natural History Survey and University of Illinois at Champaign-Urbana.

Research interests: Natural resource conservation genetics; factors controlling reproductive success in fishes; evolution of reproductive behaviors in fishes; impacts of catch-and-release angling; evolution of gene regulatory mechanisms; developmental and biochemical genetics of fishes.

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

Annual monitoring of individual reproductive success can offer insight into the variation in mating and reproductive success for many species of fish, especially in species with extended

parental care. Our group has been monitoring the reproductive activities of both largemouth and smallmouth bass at several sites within Lake Opinicon, including 4 islands and 2 km of shoreline for over ten years. These habitats have been surveyed annually during the spawning season by visual swims using a mask and snorkel. Data collected included 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 one and two year old 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 then calculate total fry production for each site each year. These data can then be correlated with year class strength one and two years later.

Project Team Members: David Philipp, Julie Claussen, Brandon Barthel, Kyle Hanson, Caleb Hasler, Jeff Stein

Brandon Barthel - "Factors influencing individual and population level reproductive success of smallmouth bass (*Micropterus dolomieu*)" - PhD thesis

This project has monitored smallmouth bass reproduction in a connected river-lake section of the Mississippi River since 1996. Snorkeling surveys have evaluated which males successfully raised broods in each year. The capture and tagging of individual males allows us to evaluate lifetime reproductive success and nest site choice across multiple years. We've discovered that the vast majority of male smallmouth bass show fidelity to either the river or the lake as reproductive habitat, with many males exhibiting a potamodromous life history (migrating from the lake to the river to spawn). Males that spawn in the river are consistently smaller and mature at younger ages than males spawning in the lake. Stochastic hydrologic events have been observed to have a great effect on the reproductive success of males spawning in the river. The next stage of the study is to apply microsatellite DNA markers to investigate genetic relationships of adults nesting throughout the system as well as determine which nesting males have contributed to population recruitment. Tissue samples collected from nesting males, sub-samples of broods, and one year old juveniles will allow paternity analysis, by which we will determine which nesting males produced the offspring that survived to constitute each year class in the system. This data will provide insight into what factors are influencing the reproductive success of individual males, as well as population persistence. These analyses are in early stages.

Assistants: Olivia Dorthy, Matt King, Aaron Shultz, Julie Claussen, Jim Ludden, Jana Svec.

Kyle Hanson - "Behaviour, activity, and depth distribution of a piscivorous north temperate fish across an entire year as revealed by a 3D whole-lake telemetry array: role of environmental factors and sex" - Masters thesis

An underwater acoustic telemetry array was installed in Warner Lake, eastern Ontario in November of 2003. The array enables the real-time 3-dimensional positioning of numerous fish for extended durations. The current study has been used to analyze bass behavior across an entire year. In November of 2004, 20 acoustic transmitters were implanted in largemouth bass in the lake. These fish were continuously tracked by the hydrophone array through November of

2005. Preliminary data analyses into the relations of depth distribution and daily movement across the seasons and between sexes have been performed. Largemouth bass activity is largely related to water temperature, with fish being most active during the hot summer months and least active during winter under ice. Thus far, it has been noted that sex specific differences in activity and depth distribution occur at various times during the year. Reproductive male fish were less active and inhabited shallower depths during the spawning and post reproductive time periods than other fish. Non-reproductive male and female fish behaved similarly throughout the year. While differences in activity and depth utilization of largemouth bass are primarily driven by water temperature, sex and reproductive status play important roles during and after the spawning period.

Assistants: Caleb Hasler, Steven Cooke, Kevin Esseltine, Jeff Stein, Cory Suski

Aaron Shultz - “Assessing The vulnerability of nesting male Largemouth Bass and Smallmouth Bass to angling” - Masters thesis

Male largemouth bass exhibit extended male parental care, a reproductive trait that can potentially make them susceptible to angling activities. In this study, the vulnerability of nesting male bass was assessed in environments with different levels of angling pressure. The four study locations are Long Lake, Millers Lake, and Loughborough Lake located in Southern Ontario and Lincoln Trail Lake located in Central Illinois. The level of aggression nesting male bass had toward lures was tested, as well as the effects of repeated angling events over successive days. Results indicate that male bass become less aggressive toward lures over time. Research into what is driving decreased aggression and if bass retain learned lure recognition from one spawning period to the next is in progress.

Assistants: Matt King, Caleb Hasler, Jeff Stein, Brandon Barthel,

Caleb Hasler- “Behavioural and activity patterns of acoustically tagged nesting Largemouth Bass” – Summer Project

Many studies investigating parental care in centrarchids have been based on fine spatial scale visual observations, but at coarse temporal scales; often less than one observation a day during the spawning period. With the installation of the hydrophone array at Warner Lake, it became possible to obtain fine-scale (< 1 min) data for nesting largemouth bass throughout their spawning period. To examine the effects of varying degrees of angling procedures on the activity and behaviour of nesting largemouth bass we affixed high-resolution acoustic tags (2.5 second repetition rate, sub-meter accuracy) to 16 nesting largemouth bass during the spawning period at Warner Lake. Eight fish were tagged, measured, and released within 5 minutes of capture near their nest, while eight others were tagged, measured, held for 2 hours, air exposed, and released approximately 200 m from their nest. The data are being processed to determine if differences exist between the treatments in relation to daily travel of the fish, nest development, home range size, and movements away from nest. Most importantly, the results will show how parental care in centrarchids is affected by angling events.

Collaborators: Kyle Hanson, Dr. Steve Cooke, Dr. Cory Suski, Frank Phelan, and Dr. Bruce Tufts

Dr. Laurene Ratcliffe, Department of Biology, Queen's University

“Behaviour and Conservation Ecology of Birds”

My research program at QUBS has expanded from its original focus on communication and sexual selection to include conservation ecology and behaviour of Neotropical migrants. In 2005 three new projects were initiated at QUBS, each capitalizing on exciting new methodologies available through collaboration with colleagues. Our tests of network communication in chickadees (Foote, PhD) are carried out in conjunction with Dr. Dan Mennill (Windsor) and Queen's Biological Communication Centre (Dr. Kevin Munhall, Psychology). Stable-isotope studies of warblers (Reudink PhD, Fraser MSc) involve Dr. Pete Marra (Smithsonian/Queen's), Dr. Ryan Norris (UBC/Guelph), and Dr. Kurt Kyser (Geological Sciences, Queen's).

Jennifer Foote – “Is the dawn chorus an interactive communication network in black-capped chickadees?” -PhD thesis

Growing evidence supports the idea that most animal communication involves networks involving multiple signallers and receivers. The dawn chorus may allow territorial birds to adjust social relations with their neighbours by interactive communication (social dynamics hypothesis). In 2005 Jenn began investigating whether male chickadees engage in network communication at dawn, using a 16-microphone array to simultaneously record neighbourhoods of four to eight chorusing males. An intense field effort resulted in multiple repeated recording of entire choruses of several neighbourhoods throughout the females' fertile period. Analysis of these singing interactions, combined with data from the previous winter on individual male social rank, and male genetic success will be used to determine 1) how dominance is related to chorusing behaviour, 2) whether males communicate with multiple neighbours, and 3) whether third-party eavesdropping occurs. In 2006, experimental manipulation of chorus dynamics using playback is planned.

Assistants: Roger Bull, Mary Stapleton, Dominique Potvin

Matt Reudink- “Carry-over effects in redstarts: implications for sexual selection and behaviour” -PhD thesis

Stable-isotope analysis of tissue (e.g. blood, feathers) has recently emerged as a useful tool for examining the effects of seasonal interactions on population ecology and conservation of migratory birds. In 2005 Matt began a study of American redstarts (*Setophaga ruticilla*) on both wintering (Jamaica) and breeding grounds (QUBS), to determine how carry-over effects from previous seasons influence sexual selection and behaviour. Previous work on this population at QUBS has shown winter habitat quality affects male breeding success. Matt's project focuses on the role of plumage during both phases of the annual cycle, specifically (1) the relation between

male parental investment, moult, and winter territory acquisition, and (2) the relation between plumage expression and male social and genetic reproductive success.

Assistants: Stephanie Doucet, Susie Crowe, Javier Salgado-Ortiz, Katie Langin

Kevin Fraser – “Using stable-isotope analysis of toenails to measure migratory connectivity in Golden-winged Warblers” – MSc thesis

Golden-winged Warblers (GWWA) have shown a rapid rate of decline throughout much of their range, in part due to hybridisation with sister species, the Blue-winged Warbler, in areas of contact. Understanding the degree to which breeding populations of GWWA are linked with their southern winter range, both in the past and at present, may be useful for conservation efforts. Kevin’s project asks whether contemporary and historical deuterium signatures obtained from toenail samples collected from breeding birds at QUBS and other locales, as well as museum specimens, is a useful approach. He is also investigating the utility of trace element analysis of toenail layers (obtained by laser ablation) from birds sampled over the breeding season at QUBS

Assistants: Sheri Harper

Publications:

- Christie, P. J., Mennill, D. J. and L.M.Ratcliffe. 2004. Pitch shifts and song structure indicate male quality in the dawn chorus of black-capped chickadees. *Behavioral Ecology and Sociobiology* 55: 341-348.
- Christie, P. J., Mennill, D. J. and L. M.Ratcliffe. 2004. Chickadee song structure is individually distinctive over long broadcast distances. *Behaviour* 141: 101-124.
- Doucet, S.M., Mennill, D.J., Montgomerie, R.D., Boag, P.T. and L. Ratcliffe. 2005. Achromatic plumage reflectance predicts reproductive success in male black-capped chickadees. *Behavioral Ecology* 16: 218-222
- Mennill, D.J. and L. M. Ratcliffe. 2004. Nest cavity orientation in black-capped chickadees (*Poecile atricapillus*): Do the acoustic properties of cavities influence patterns of nest entrance orientation? *Journal of Avian Biology* 35:477-482.
- Mennill, D.J. and L.M. Ratcliffe. 2004. Overlapping and matching in the song contests of black-capped chickadees. *Animal Behaviour* 67: 441-450.
- Mennill, D.J. and L. M. Ratcliffe . 2004. Do male black-capped chickadees eavesdrop on song contests? A multi-speaker playback experiment. *Behaviour* 141: 125-139.
- Mennill, D. J., Ramsay, S. M., Boag, P. T. and L. M.Ratcliffe. 2004 Patterns of extra-pair mating in relation to male dominance status and female nest placement in black-capped chickadees. *Behavioral Ecology* 15: 757-765.
- Norris, D.R., Marra, P.P., Kyser, T.K. and L. M. Ratcliffe. 2005. Tracking habitat use of a long-distance migratory bird, the American redstart *Setophaga ruticilla*, using stable-carbon isotopes in cellular blood. *Journal of Avian Biology* 36: 164-170.
- Norris, D.R., Marra, P.P., Kyser, T.K., Sherry, T.W. and L. M. Ratcliffe. 2004. Tropical winter habitat limits reproductive success on the temperate breeding grounds in a migratory bird. *Proceedings of the Royal Society London: Series B* 271: 59-64.

- Otter, K. and L. Ratcliffe. 2005. Enlightened decisions: female assessment and communication networks. Pp 133-151 In McGregor, P.K. (ed) Communication Networks. Cambridge University Press.
- Ratcliffe, L., Mennill, D.J. and K.A. Schubert. Social dominance and fitness in black-capped chickadees. In Otter, K. A. (ed) Ecology and Behaviour of Chickadees and Titmice: an Integrated Approach. Oxford University Press (accepted with minor revisions 20 Dec 2005)
- Schubert, K.A., Mennill, D.J., Ramsay, S. M., Otter, K. A., Boag, P.T. and L.M. Ratcliffe. Variation in social rank acquisition influences lifetime reproductive success in black-capped chickadees. Biological Journal of the Linnean Society: in press (accepted 27 July 2005)
- Smulders, T.V., Lisi, M.D., Tricomi, E., Otter, K.A., Chruszcz, B., Ratcliffe, L.M. and T.J. DeVoogd. Seasonality in the song system nuclei of the black-capped chickadee (*Poecile atricapillus*). Journal of Neurobiology: in press (accepted 15 Feb 2006)
- Tarof, S.A. and L. M. Ratcliffe. 2004. Habitat characteristics and nest predation do not explain clustered breeding in least flycatchers (*Empidonax minimus*). The Auk 121: 877- 893.
- Tarof, S.A., Ratcliffe, L. M, Kasumovic, M. M. and P.T. Boag. 2005. Are least flycatcher (*Empidonax minimus*) clusters hidden leks? Behavioral Ecology 16: 207-217.
- Weisman, R. and L. Ratcliffe. 2004. Relative pitch and the song of black-capped chickadees. American Scientist 92: 532-539.
- Woodcock, E.A., Rathburn, M. K. and L. M. Ratcliffe. 2005. Achromatic plumage reflectance, social dominance and female mate preference in black-capped chickadees (*Poecile atricapilla*). Ethology 111: 1-10.

Dr. Raleigh J. Robertson - Department of Biology, Queen's University

"Behavioural Ecology and Conservation Biology of Birds"

The 'RJR Bird Lab' field program in 2005 focused on Tree Swallows, Golden-winged Warblers, and collaborative work with Jan Lifjeld on Barn Swallows. The **Tree Swallow** studies involved maintaining our nest-box grids, monitoring nesting success and conducting a pilot study on mate-choice copying. This work was done by post-doc **Mary Stapleton**, with assistance from **Javier Salgado**, **Sylvia Wood** and **Jimmy Pai**. The **Golden-winged Warbler** project involved honours thesis projects by **Sheri Harper** and **Emily McKinnon**, with help from **Anna Yunnie**. This work on Golden-wings was done in conjunction with the project of M. Sc. student Kevin Fraser, who is being supervised by Laurene Ratcliffe. Finally, the **Barn Swallow** work, being supervised by **Jan Lifjeld**, involved **Oddmund Kleven** and **Frode Jacobsen**, with an additional **Museum Project** conducted by **Frode Jacobsen**.

"Mate choice copying in Tree Swallows"

Extra-pair paternity (mating outside the social pair bond) is a common mating strategy among avian species. Tree swallows exhibit one of the highest levels of extrapair paternity ever found, with as many as 84% of females producing extrapair young. The link between copulation

rates and patterns of extrapair paternity are unclear, especially in tree swallows where withinpair copulations are extremely frequent, while extrapair copulations are rarely seen. The goal of our investigation was to quantify within-pair copulation rates in our study population of tree swallows in order to examine potential correlations between within-pair copulation rates and levels of extrapair paternity. To that end, we conducted extensive copulation watches to document frequency of copulation by each pair of tree swallows nesting on the Hughson's Grid. We then obtained family group blood samples that will be used to determine paternity using molecular genetic analysis.

The Tree Swallow studies rely on permanent grids of nest-boxes on the Hughson Tract of QUBS. In 2005, post-doc **Mary Stapleton** supervised the field studies, with assistance from **Sylvia Wood, Javier Salgado-Ortiz and Jimmy Pai**.

Sherilee Harper - "Song and mating success in Golden-winged Warblers" - BSc Honours thesis

Golden-winged warblers have moderately high levels of extra-pair paternity, and they are also known to hybridize with the closely related Blue-winged Warbler. In an effort to determine factors that influence mate choice, we recorded dawn songs of over 20 resident males. We also took family group blood samples to allow paternity analysis. With the help and co-supervision of Rachel Fraser, paternity analysis is nearing completion and the song variables have been quantified. The song characteristics of extra-pair males will be compared with those of the pair males to determine whether song influences the female's likelihood or choice of obtaining extra-pair fertilizations.

Emily McKinnon - "Plumage correlates of mating success in Golden-winged Warblers" - BSc Honours thesis

The black throat-patch of male Golden-winged Warblers is displayed prominently during bouts of singing. This study documents the variability in size and in UV reflectance of the throat patch of male Golden-wings. It will also relate characteristics of the throat patch to measures of breeding success, such as pairing success and first egg date. Males were captured by mist-net, and with the help of a camera set-up to ensure consistent posture and camera angle, male throat-patch was photographed. A few feathers were plucked from the throat-patch for subsequent UV analysis in the lab.

The Golden-winged Warbler studies rely on successional and scrub habitats on the Pangman (Lindsay Lake Road), Bonwill, Hughson and Bracken Tracts of QUBS.

This study was aided by the assistance of **Stephanie Doucet** for advice on the UV techniques, plus **Kevin Fraser** in the field, and **Anna Yunnice** for field assistance.

Oddmund Kleven - "Adaptive function of extra-pair mating in Barn Swallows" - Ph.D. thesis Natural History Museum, University of Oslo, Norway.

Supervisor, Dr. J.T. Lifjeld. - project in collaboration with Raleigh Robertson

Many current hypotheses regarding the adaptive value of extra-pair mating suggest an advantage of increased genetic heterozygosity, suggesting that extra-pair mates are genetically

more different from females than are their social mates. Having found that, contrary to expectations, extra-pair mates of Barn Swallows were *more* closely related to the female than was a randomly chosen male, and that there was a tendency for females to be more closely related to the extra-pair male than the within pair male, the focus in 2005 was to obtain additional family genetic data to further examine the genetic relationships of extra-pair mate choice.

The 2005 studies focused on colonies of barn swallows in the boathouse at QUBS, the barn on Massassauga Road, and on the large colony under the Loughborough Lake Bridge. The latter is made accessible by use of Frank's barge, and the docking space by the Trainor family, and for both we express our appreciation.

Assistant: Frode Jacobsen

Publications

- Barber, C.A., M.J. Edwards, and R. J. Robertson. 2005. A test of the genetic compatibility hypothesis with tree swallows, *Tachycineta bicolor*. *Canadian Journal of Zoology* 83: 955-961.
- Barg, J.J., J. Jones, and R. J. Robertson. 2005. Describing breeding territories of migratory passerines: suggestions for sampling, choice of estimator, and delineation of core areas. *Journal of Animal Ecology* 74: 139-149.
- Gibb, C.E., J. Jones, M.K. Girvan, J.J. Barg and R.J. Robertson. 2005. Geographic variation in prevalence and parasitemia of *Haemoproteus paruli* in the cerulean warbler (*Dendroica cerulea*). *Canadian Journal of Zoology* 83: 626-629.
- Jones, J., C. E. Gibb, S.C. Millard, J.J. Barg, M.K. Girvan, M.L. Veit, V.L. Friesen and R.J. ROBERTSON. 2005. Multiple selection pressures generate adherence to Bergmann's rule in a Neotropical migratory songbird. *Journal of Biogeography* 32: 1827-1833.
- Jones, J. W.J. McLeish, and R.J. Robertson. 2004. Predicting the effects of Cerulean Warbler, *Dendroica cerulea* management on Eastern Ontario bird species. *Canadian Field-Naturalist* 118: 229 - 234. (although dated 2004, this paper did not appear until April 2005, so was not included in the 2004 Report).
- Kleven, O., F. Jacobsen, R.J. Robertson and J.T. Lifjeld. 2005. Extrapair mating between relatives in the barn swallow: a role for kin selection? *Royal Society - Biology Letters* 1: 389-392.
- Kleven, O., F. Jacobsen, R. Izadnegahdar, R.J. Robertson and J. Lifjeld. 2005. Male tail streamer length predicts fertilization success in the North American barn swallow (*Hirundo rustica erythrogaster*). *Behavioural Ecology and Sociobiology* 59(3): 412-418. (Received: 9 March 2005, Revised: 28 May 2005, Accepted: 9 July 2005, Published online: 12 October 2005)
- Sæther, B.-E. , S. Engen, A.P. Moller, M.E. Visser, E. Matthysen, W. Fiedler, M.M. Larmbechts, P.H. Beekers, J.E. Brommer, J. Dickensen, C. du Feu, F.R. Gehlbach, J. Merilä, W. Rendell, R.J. Robertson, D. Thomson and J. Török. 2005. Time to extinction of bird populations. *Ecology* 86(3): 693-700.
- Sæther, B.-E., R. Lande, S. Engen, H. Weimerskirch, M. Lillegård, R. Altwegg, P. H. Becker, T. Bregnballe, J. E. Brommer, R. H. McCleery, J. Merilä, E. Nyholm, W. Rendell, R.J. Robertson, P. Tryjanowski & M. E. Visser. 2005. Generation time and temporal scaling

of bird population dynamics. *Nature* 436 (7 July 2005): 99 - 102.
(doi:10.1038/nature03666).

Veit, M.L., R.J. Robertson, P.B. Hamel and V.L. Friesen. 2005. Population genetic structure and dispersal across a fragmented landscape in cerulean warblers (*Dendroica cerulea*). *Conservation Genetics* 6: 159-174.

Theses

Kleven, O. 2006. Adaptive function of extrapair paternity in barn swallows and reed buntings. Ph.D. dissertation, Faculty of Mathematics and Natural Sciences, University of Oslo, Norway. Supervised by Dr. Jan T. Lifjeld. (defended 3 February 2006).

Stapleton, M.K. 2005. Extrapair mating in Tree Swallows: An examination of the genetic compatability hypothesis. 110 pp. Ph.D. thesis. (January 2005). Queen's University.

Reed, L. 2005. Nestling feeding rates in an introgressed population of Golden-winged Warblers (*Vermivora chrysoptera*). 38pp. B.Sc. Honours thesis. (April 2005). Queen's University.

Wood, S.L.R. 2005. Inter-and intra-clutch patterns of resource allocation in Barn Swallows (*Hirundo rustica erythrogaster*). 49pp. B.Sc. Honours Thesis (April 2005). Queen's University.

Dr. Tom Sherratt - Department of Biology, Carleton University, Ottawa

Christopher Beatty - "The function of andromorphism in damselflies" - PhD thesis.

Chris set up experiments at Barbs marsh in which he released male sedge sprite *Nehalennia irene* (Odonata:Zygoptera) that had been painted in certain ways, into cages. Using this design he quantified the rate of harassment of males by other males in the cage, and thereby evaluated the benefits of exhibiting male-like signals. This work will form the final chapter of his PhD thesis, and is currently being written up for publication.

Arash Rashed - "Wasp mimicry in hoverflies" - PhD thesis

Arash and Imran Khan (NSERC Summer student) visited QUBS to collect insect specimens (mimetic hoverflies) for their experiments in Ottawa. This work tested whether wasp-like hoverflies may gain a competitive advantage from their resemblance to wasps when feeding on flowers. The work has recently been submitted for publication.

Assistant: Imran Khan

Cory Warmington - "The frequency of adromorphs in damselfly populations" -B.Sc. thesis

Female *Nehalennia irene* are dimorphic (andromorph and gynomorph). Cory quantified the proportion of females that were andromorphic at different freshwater sites and at different distances from the water's edge. He found no evidence to support the contention (Forbes et al. 1991, *Ecoscience*) that andromorph frequency varies with male density, although andromorph frequency did vary significantly among sites.

David F. Sherry - Department of Psychology & Graduate Program in Neuroscience,
University of Western Ontario, London ON Canada N6A 5C2

"Behavioural, Cognitive and Neuroanatomical Sex Differences in the Brown-headed Cowbird

Sex differences in cognition result from specialization for the performance of specific cognitive tasks. In many mammals, including humans, males show better performance on spatial tasks than females do, probably as a result of selection for the ability to navigate larger male home ranges. Our research with brown-headed cowbirds, however, suggests females may be better at spatial tasks than males. Cowbirds are brood parasites. Females search for host nests but males do not. Our previous research showed that the hippocampus – a part of the brain involved in memory and spatial ability – is larger in female cowbirds than in males. At QUBS we collected cowbirds to be trained on laboratory tasks that compare male and female spatial and non-spatial abilities. In this way we will be able to determine whether sex differences in ecology and the brain are correlated with sex differences in memory and cognition.

Sara B. Lattanzio - "Sex differences in memory and cognition in Brown-headed Cowbirds"
- Ph.D. Program in Psychology, University of Western Ontario

Male and female brown-headed cowbirds obtained at QUBS were trained at the University of Western Ontario to peck a computer touch screen to obtain food. The touch screen allows us to present a wide variety of visual stimuli to the birds. In a typical task, coloured shapes appear on the screen and birds must discover by pecking which ones produce food. After a delay, stimuli re-appear in an altered arrangement and birds must remember either the spatial location of the correct stimulus or its distinguishing features. Preliminary data show better performance by females on both spatial and non-spatial versions of the task.

Her research is supported by the Natural Sciences and Engineering Research Council of Canada and the University of Western Ontario Academic Development Fund.

Publications

- Sherry, D.F. & Hoshoooley, J.S. (in press) The neurobiology of spatial ability. In: Otter, K. (ed.) *Parid Evolution and Behavior*. Oxford University Press.
- Phillmore, L.S., Hoshoooley, J.S., Sherry, D.F. & MacDougall-Shackleton, S. A. (in press) Annual cycle of the black-capped chickadee: seasonality of singing rates and vocal control brain regions. *Journal of Neurobiology*.
- Sherry, D.F. & Mitchell, J.B. (in press). The neuroethology of foraging. In: Stephens, D.W., Ydenberg, R.C. & Brown, J.S. (eds.) *Foraging*. University of Chicago Press.
- Sherry, D.F. (2006) Neuroecology. In: Fiske, S.T., Schacter, D.L., & Zahn-Waxler (eds.). *Annual Review of Psychology Vol 57* (pp.167-197) Chippewa Falls WI: Annual Reviews.
- Sherry, D.F. (2005) Do ideas about function help in the study of causation? *Animal Biology* 55, 441-456.

- Sherry, D.F. (2005). Brain and behaviour. In: Bolhuis, J.J. & Giraldeau, L. A. (eds.) *The Behavior of Animals: Mechanism, Function, and Evolution*. (pp. 97-118) Oxford: Blackwell Publishers.
- Hoshooley, J.S. and Sherry, D.F. (2004). Neuron production, neuron number, and structure size are seasonally stable in the hippocampus of the food-storing black-capped chickadee (*Poecile atricapillus*). *Behavioral Neuroscience*, 118, 345-355.
- Sherry, D.F. (2004). Asking 'how?' versus asking 'why?' Review of *Why Men Won't Ask for Directions* by R.C. Francis. *Cerebrum* 6, 89 -98.

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

"Water Mite Parasitism of Aquatic Insects"

My research effort in Summer 2005 was divided among three projects, two of which centered on seasonal sex ratio bias in *Arrenurus* spp. mites. From previous laboratory studies, individual female *Arrenurus manubriator* (that forego larval parasitism) have sex ratios of offspring ranging from profound male-bias to profound female-bias, with a continuous gradient between these extremes. Most mites have strong first-male sperm precedence, and the generations of most *Arrenurus* species are temporally discrete, so early male production would be advantageous compared to late-season production of males. There is no disadvantage to producing females at any time, so averaged across the population, sex ratio of newly transformed adults should be unbiased in early season and shift to being profoundly female-biased by the end of the reproductive period.

The first project was a direct test of this using *A. manubriator*, in which I could rear progeny of individual females. There was no evidence of a seasonal shift in sex ratio. This may be because populations of *A. manubriator* are exceptional, having the potential for multiple and overlapping generations within one year, which would preclude any advantage to the seasonal shift.

The second project involved *A. reflexus*, which has larvae parasitic on *Leucorrhinia intacta* dragonflies, and that produces a single discrete generation per year. Because of the parasitic association and hosts that cannot be maintained in the laboratory, it is impossible to separately rear progeny of individual females. However, 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. It is therefore still possible to record a seasonal shift in sex ratio by raising mites from hosts collected at intervals over the 8-10 week flight season. The same pattern was seen as last year: a strong seasonal shift from more or less equal sex ratios to profoundly female-biased sex ratios.

The third project was on the apparent asynchronous larval engorgement observed in *Arrenurus fissicornis* on *Libellula luctuosa* dragonflies. it is typical for engorgement to be highly synchronous, given that all larval mites attach when the host emerges from the water. For comparison, I was also measuring engorgement in *A. reflexus* parasitic on *L. intacta* dragonflies. There is indeed profound variability in engorgement in *A. fissicornis* when compared to *A. reflexus*. *Arrenurus fissicornis* attached at intersegmental membranes were typically much

larger, and there was a progressive decline in engorgement with distance from these membranes. Whether larvae attached in suboptimal locations engorge sufficiently to metamorphose is still unclear. I am speculating that this represents an adaptation by the host, to limit engorgement success of larval mites and thus limit damage to and nutritional drain on the host. From the mites' perspective, there is profound intraspecific competition for sites on this host when compared to mite parasitism on other dragonfly species.

Dr. Bruce Tufts - Department of Biology, Queen's University

Caleb Hasler- “Winter distribution of Largemouth Bass in relation to dissolved oxygen and temperature” – MSc Thesis

Winter distributions of largemouth bass have previously been shown to be influenced by dissolved oxygen concentration and temperature. To date, studies reporting these results have typically been completed at coarse spatial and temporal scales. Recently, Warner Lake was outfitted with a stationary acoustic tracking array permitting the 3D location determination of fish on a near real-time basis. In the current study, nine largemouth bass were implanted with acoustic tags and continuously followed during the fall, winter, and early spring, and their locations were compared to concurrent water temperature and dissolved oxygen within the lake. Results thus far suggest parts of the lake become hypoxic after ice cover, while temperature remains relatively homogenous. Fish are congregate in areas with higher levels of dissolved oxygen and avoid areas of hypoxia. Also, fish in areas of lower dissolved oxygen concentrations have higher daily distance traveled. Results will aid in management of freshwater fisheries and will contribute to the knowledge of the ecology of largemouth bass.

Collaborators: Kyle Hanson, Dr. Dave Philipp, Dr. Steve Cooke, Dr. Cory Suski, Frank Phelan

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

"Long-term Studies of Snakes and Birds"

The long-term study of black ratsnakes continued in 2005. 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 northern watersnakes and red-winged blackbirds is ongoing. In the case of the red-winged blackbirds, analyses revealed several pronounced long-term demographic trends associated with climate variation. In 2005 I repeated collection of breeding data on several of the marshes used previously to document the current status of the population and to see whether that status was consistent with predictions based on recent climate conditions.

Assistant: Kit Muma

Publications:

- Blouin-Demers, G., H.L. Gibbs & P.J. Weatherhead. 2005. Genetic evidence for sexual selection in black ratsnakes (*Elaphe obsoleta*). *Animal Behaviour* 69:225-234.
- Blouin-Demers, G., P.J. Weatherhead & J.R. Row. 2004. Phenotypic consequences of nest site selection in black ratsnakes (*Elaphe obsoleta*). *Canadian Journal of Zoology* 82:449-456.
- Brown, G.P. & P.J. Weatherhead. 2004. Sexual abstinence and the cost of reproduction in adult male watersnakes, *Nerodia sipedon*. *Oikos* 104:269-276.
- Cooke S.J., D.P. Philipp, D.H. Wahl & P.J. Weatherhead. 2006. Energetics of parental care in six syntopic centrarchid fishes. *Oecologia*, in press.
- Kissner, K.J. & P.J. Weatherhead. 2005. Phenotypic effects on survival of neonatal northern watersnakes. *Journal of Animal Ecology* 74:259-265.
- Kissner, K.J., P.J. Weatherhead & H.L. Gibbs. 2005. Experimental assessment of ecological and phenotypic factors affecting male mating success and polyandry in northern watersnakes. *Behavioral Ecology and Sociobiology* 59:207-214.
- Weatherhead, P.J. 2005. Effect of climate variation on timing of nesting, reproductive success and offspring sex ratios of red-winged blackbirds. *Oecologia* 144:168-175.
- Weatherhead, P.J. 2005. Long-term decline in a red-winged blackbird population: ecological causes and sexual selection consequences. *Proceedings of the Royal Society of London B* 272:2313-2317.
- Weatherhead, P.J. & K.W. Dufour. 2005. Limits to sexual size dimorphism in red-winged blackbirds: the cost of getting big? *Biological Journal of the Linnean Society* 85:353-361.
- Weatherhead, P.J. & G. Blouin-Demers. 2004. Understanding avian nest predation: why ornithologists should study snakes. *Journal of Avian Biology* 35:1-6.
- Weatherhead, P.J. & G. Blouin-Demers. 2004. Long-term effects of radiotelemetry on black ratsnakes. *Wildlife Society Bulletin* 32:900-906.

Dr. Lorne M. Wolfe - Dept. of Biology, Georgia Southern University, Statesboro, GA. USA
and

Dr. Douglas R. Taylor - Dept. of Biology, University of Virginia, Charlottesville, VA. USA.

"The Ecological Genetics of Invasiveness in *Silene latifolia*"

Biological invasions represent one of the greatest threats to the preservation of biodiversity. In addition, the economic costs to the USA resulting from damage and control of alien organisms (e.g. zebra mussel, kudzu) amounts to more than \$100 billion annually. Surprisingly, very little is known about why species that are normally benign, suddenly become noxious pests following their introduction to another country or continent. While the emphasis of previous research in the literature has been on ecological forces, the goal of this research is to explore the role that genetic changes play in the invasion process.

Taylor and Wolfe propose to study the genetics and origin of invasiveness using a combination of approaches in *Silene latifolia*, a plant that was introduced to North America from Europe. There are three goals to this research. 1) To examine the history of the invasion process, and clarify the genetic consequences of the invasion process in terms of the amount and distribution of genetic variation. 2) To experimentally test for unique environmental patterns in

North America that might promote the success of weedy species. 3) To use replicated experimental populations to test whether North American populations are genetically more invasive and the extent that natural enemies limit invasiveness in Europe. This research will have broad significance in terms of understanding the origin of invasiveness as well as providing opportunities for the career development of undergraduate students, graduate students and post-docs.

PhD student: Dexter Sowell,

MS student: Brandy Penna

Publications

Blair, A.C. and L. M. Wolfe. 2004. The Evolution of an Invasive Plant: An Experimental Study with *Silene latifolia*. Ecology 85:3035-3042.

Dotterl, S, L.M. Wolfe and A. Jurgens. 2005. Qualitative and quantitative analyses of flower scent in *Silene latifolia*. Phytochemistry 66:195-205.

Taylor, D. R., and S. R. Keller. Historical range expansion influences the genetics of two contemporary species invasions. Evolution (in review).

Wolfe, L.M., A.C. Blair and B. Penna. Does intra-specific hybridization contribute to the evolution of invasiveness?: an experimental test. Evolution (in press).



Chickadee Crew (BCH) - Dr. Dan Mennill, Ann MacKellar, Jenn Foote, Dominique Potvin and Lauren Reed

Summary of Seminars at QUBS in 2005

Issues in Conservation Biology
Seminars dealing with a diversity of issues in the discipline of conservation Biology
hosted by
The Baillie Family Chair in Conservation Biology

Tuesday May 3

Dr. Jan Lifjeld (Professor Natural History Museum, University of Oslo, Norway)
"Inbreeding avoidance, kin selection and mating systems evolution in birds"

Wednesday May 4

Dr. P.G. Bentz (Bird Tour Guide and Photographer)
"Wings over Falsterbo-bird migration on the southern tip of Sweden"

Monday May 9

Dr. Peter O. Dunn (Associate Professor, Department of Biological Sciences,
University of Wisconsin-Milwaukee)
"Conservation genetics of the Greater Prairie-chicken"

Wednesday May 31

Dr. Beth MacDougall-Shackleton (Department of Zoology, University of Western
Ontario, London, Ontario)
"Causes and consequences of population genetic structure in songbirds"

Wednesday June 1

QUBS Regulars - in house Meet the Regulars at QUBS/"What are you up to?"

Wednesday June 8

QUBS Regulars - in house Meet the Regulars at QUBS/"What are you up to?"

Thursday June 30

Dr. Raleigh Robertson (Department of Biology, Queen's and outgoing QUBS
Director)
"Recalling 33 years as Director and handing over the directorship of QUBS"
Dr. Bruce Tufts (Department of Biology, Queen's and incoming QUBS Director)
"Who is this guy?"

Wednesday July 6

Kevin Esseltine (Department of Biology, Queen's and now at Ontario Ministry of
Natural Resources, Kingston)
"Physiological consequences of decompression in small mouth bass" - Master's
thesis defense seminar - supervisor Dr. Bruce Tufts

Wednesday July 13

Mike Runtz (Department of Biology, Carleton University, Ottawa, Ontario)
 "Rock and water, moose and wolves: Natural history of Algonquin Park"

Wednesday July 20

Dr. James Fullard (Department of Zoology, Erindale College of University of
 Toronto, Mississauga, Ontario)
 "Adventures in Polynesian Entomology"

Wednesday August 3

Dr. Laurence Packer (Department of Biology, York University, Toronto, Ontario)
 "Evolution of bizarre feeding and mating morphologies in a clade of South.
 American bees "

Mon. Aug. 8

Dr. Scott Findlay (Department of Biology, University of Ottawa, Ottawa, Ontario)
 "Impacts of adjacent land use on wetland biodiversity"

Wednesday August 24

Marvin Gunderman (Department. of Biology, McMaster University, Hamilton,
 Ontario)
 "Biodiversity of insects: Taxonomy and adaptation"



Summary of Conference, Field Trip and Meeting Use of QUBS in 2005

Organizer	Function	Numbers	Duration
Diane Lawrence Queen's - MacArthur College	Environmental Education Field Trip	20	Jan 8-9
Rasa Izadneghadar Queen's - SUNSIH	Student University Network for Social and International Health Executive Retreat	8	Jan 14-16
Tanya MacDonald Queen's - QPID	Queen's Program in International Development Executive Retreat	17	Jan 21-22
Kathy Marrocco Amherstview Public School	Counselling and Skills Development Class Field Trip	16	Jan 26 - 28
Dr. Chris Eckert Queen's - Biology	Bio 439 - Natural Selection and Microevolution Field Trip	18	Feb 12-13
Alex Burns Queen's - SQ	Science Quest Workshop	10	March 4-5
Ryan Germain Queen's - SCB	Society for Conservation Biology Field Trip	10	March 27
Dr. Virginia Walker Queen's - Biology	Modern Insect Science Field Trip	20	April 2
Tim Demmons Opeongo High School	Ecology and Ecological Methods Field Trip	24	April 25-26
Dr. Shelley Arnott Queen's - Biology	<i>Bythotrephes</i> Workshop	30	April 26-28
Dan Selbie Queen's - Biology	Mini-enrichment Field Trip on Aquatic Biology	23	May 11
Jim Ludden CoD, Glen Ellyn, Illinois	Collge of DuPage Field Course	13	June 6-10
Jennifer Aikman/Sylvia Strobl OMNR - Peterborough	Ecological Land Classification Course	25	June 13-17

Summary of Conference, Field Trip and Meeting Use of QUBS in 2005 (cont'd)

Organizer	Function	Numbers	Duration
Jim Ronson RVFN	Rideau Valley Field Naturalists Field Trip	18	June 19
Barbara/Spider Miller Lake Opinicon	50th Wedding Anniversary Celebration	80	July 24
Bob Crandall Queen's - RAQ	Rertirees at Queen's Field Trip and Picnic	20	July 27
Dr. Mel Robertson Queen's - Biology	Departmental Picnic and Tribute to Dr. Raleigh Robertson - outgoing Director	95	July 29
Hague Vaughan Env Canada - Burlington	SAEON Tour - South Africa Environmental Organizations Network Site Visit	11	August 5
Dr. Ed Kott Wilfrid Laurier U - Biology	Senior Undergraduates Field Course	23	Aug 28 - Sept 10
Diane Lawrence Queen's - MacArthur College	Environmental Education Field Trip	34	Sept 10-11
Lynn Breker Performance Plants	Performance Plants Retreat	24	Sept 12-14
Ted Thomas NPC - Brantford	North Park Collegiate Field Trip	31	Sept 14-16
Barbara Heins Frontenac High School	Frontenac County High School Teachers Field Trip	18	Sept 23
Peter Hannah RWLT - Portland	Rideau Waterway Land Trust Annual General Meeting and Dinner	70	Sept 23
Brenda Schamehorn Queen's - Biology	Bio 302 - General Ecology Field Trip	84	Sept 24-25
Brenda Schamehorn Queen's - Biology	Bio 302 - General Ecology Field Trip	85	Oct 1-2
Dr. John Smol Queen's - Biology	Bio 335 - Limnology Field Trip	52	October 1

Summary of Conference, Field Trip and Meeting Use of QUBS in 2005 (cont'd)

Organizer	Function	Numbers	Duration
Dr. John Smol Queen's - Biology	Bio 335 - Limnology Field Trip	47	October 2
Dorothy Fazio Gartner Lee Assoc - Markham	Ecological Land Classification Course	23	Oct 3-7
Doug Archibald Queen's - Geology	Geology 211/221 - Geological Field Methods Field Trip	20	October 5
Doug Archibald Queen's - Geology	Geology 211/221 - Geological Field Methods Field Trip	20	October 6
Jeff Ridal St. Lawrence River Institute	NSERC Strategic Grant Meeting	16	Oct 18-19
Sara Dart/Angela Strecker Queen's - Biology	Graduate Student Orientation Weekend and Field Trip	50	Oct 22-23
Carlos Paz-Soldan Queen's - QPID	Queen's Program in International Development Executive Retreat	19	Oct 29-30

Documentation of Research Use of QUBS in 2005 - User-Days

User	Affiliation	Principal Investigator	Post-Doc	Graduate Student	Honours Student	Assistant	Total
Aarssen	Queen's - Biology	10	0	30	30	30	100
Arnott	Queen's - Biology	0	0	2	0	2	4
Campbell	Queen's - Biology	4	0	19	19	4	46
Casselman	Queen's - Biology	2	0	0	0	0	2
Cumming	Queen's - Biology	3	0	17	17	0	37
Grogan	Queen's - Env'tl Sciences	7	0	6	0	4	17
Keast	Queen's - Biology	81	0	0	0	0	81
Kyser	Queen's - Geology	4	0	0	0	16	20
Leggett	Queen's - Biology	2	0	0	0	0	2
Lougheed	Queen's - Biology	1	0	1	44	12	58
Montgomerie	Queen's - Biology	3	0	0	54	0	57
Moyes	Queen's - Biology	5	0	0	30	0	35
Ratcliffe	Queen's - Biology	4	0	539	119	222	884
Robertson	Queen's - Biology	41	74	31	98	130	374
Smol	Queen's - Biology	1	0	0	0	4	5
Tinline	Queen's - GIS	2	0	0	0	0	2
Tufts	Queen's - Biology	31	0	104	0	4	139
Wang	Queen's - Biology	2	0	0	0	0	2
					Queen's	Subtotal	1865
Baker	UofT, Erindale - Zoology	2	0	13	0	0	15
Blouin-Demers	Ottawa - Biology	50	0	204	139	139	532
Cooke	UBC - Ctr Appl Cons Res	12	0	0	0	0	12
Epifanio	Illinois Nat Hist Surv - Aq Biol	20	0	0	0	51	71
Forbes	Carleton - Biology	7	0	75	0	31	113
Fullard	UofT, Erindale - Zoology	47	13	70	0	83	213
Godin	Carleton - Biology	1	0	1	0	1	3
Knapp	U Oklahoma - Biology	12	0	0	0	0	12
Jones	Vassar - Biology	11	0	0	0	255	266
Lifjeld	U of Oslo - Nat Hist Mus	12	0	20	0	41	73
MacDougall-Shackleton	U Western Ontario - Zoology	48	0	0	181	0	229
Mennill	Windsor - Biology	27	0	60	0	14	101
Muma	Ithaca College - Biology	74	0	0	0	0	74
Neff	U Western Ontario - Zoology	26	0	60	78	42	206
Niezgoda	Lotek	6	0	0	0	4	10
Norris	UBC - Forest Sciences	47	0	0	0	69	116
Philipp	Illinois Nat Hist Surv - Aq Biol	85	7	149	44	100	385
Sherratt	Carleton - Biology	1	0	39	31	0	71
Sherry	U Western Ontario - Psych	5	0	0	0	0	5
Smith	Ithaca College - Biology	74	0	0	0	0	74
Taylor	U Virginia - Biology	6	0	0	0	13	19
Weatherhead	U Illinois - Ecol/Evolution	37	0	0	0	0	37
Wolfe	Georgia Southern - Biology	7	0	0	0	9	16
					Non-Queen's	Subtotal	2653
					RESEARCH	TOTAL	4518

Documentation of Use of QUBS in 2005 - User-Days

	Principal Investigator	Post-Doc	Graduate Student	Honours Student	Assistant	Total
Total Research User-Days	820	94	1440	884	1280	4518
% Queen's	25	79	52	46	33	41
% Non-Queen's	75	21	48	54	67	59
User-Days in Teaching Activities						2403
Conference, Meeting and Field Trip Use						1104
Outreach Programs						972
SWEP Program						221
Other*						1001
Grand Total User-Days**						10219

* QUBS Staff, their families and visitors are not included

** up 1.1% from 2004

*Fee Schedule for 2006***University Research and Teaching Rates**Board Charges - Meals only

\$588/month/person	-no obligation for chores
\$416/month/person	-includes obligation for chores on a rotating schedule

Accommodation Charges - Housing only - no linen service

\$45/month/person	-dormitory (White House or Curran Cottage)
\$90/month	-small cabin (Cabins 1, 4, 5, 6, 7, 11 and shaker)
\$175/ month	-medium cabin (Cabins 2, 3, 8, 9, 10, 13, 14)
\$240/month	-large cabin (Cabins 12, 15 and White House Apartment)
\$360/month	-Cottage (Keast, Earl, Sumac or Maplewood)

Room and Board Rates for Field Courses - no linen service

\$325/person	-weekly R&B for OUPFB field courses
\$360/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

\$40/day/person	-24 hr. room and board
\$6.00	-breakfast or lunch only
\$12.00	-dinner only
\$20.00	-overnight accommodation

Bench FeesBasic* 1 (MFA co-applicants and Queen's Biology researchers)

\$1.18/day	principal investigator/graduate student/lab coordinator
\$0.59/day	assistant

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

\$2.93/day	principal investigator/graduate student/lab coordinator
\$1.18/day	assistant

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

\$2.93/day	principal investigator/graduate student/lab coordinator
\$1.18/day	assistant

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

\$5.87/day	principal investigator/graduate student/lab coordinator
\$2.93/day	assistant

Basic* 3 (non-MFA non-Queen's researchers)

\$5.87/day	principal investigator/graduate student/lab coordinator
\$2.93/day	assistant

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

\$11.73/day	principal investigator/graduate student/lab coordinator
\$5.87/day	assistant

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

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

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

Fee Schedule for 2006 (continued)

Electronic Equipment Charges

Local Area Network Connection

Research Use: \$23/mo for each computer connected to the network

Internet Access

Individual Users: \$11.50/mo

GPS/GIS Equipment

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

Boat Rental

\$335/month, \$130/week - includes maintenance from normal use - gas and oil not included

\$75.00/day - includes gas and oil for one day rental

All QUBS boat users will require Operator Proficiency cards to rent a boat

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

Conference and Group Rates

\$6.00/person/day facility day use fee - no meals

\$60.00/person/day 24 hr R&B and day use - summer season (April 30 - September 10)

\$15.00/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.

QUBS Point from the air February 2006 - Katie Langin photo

