

Queen's University Biological Station Annual Report and Newsletter – 2004



***The Biological Station Dinner Bell
(Photo by Caleb Hasler)***

***Director: Raleigh Robertson Manager: Frank Phelan
Assistant Manager: Floyd Connor***

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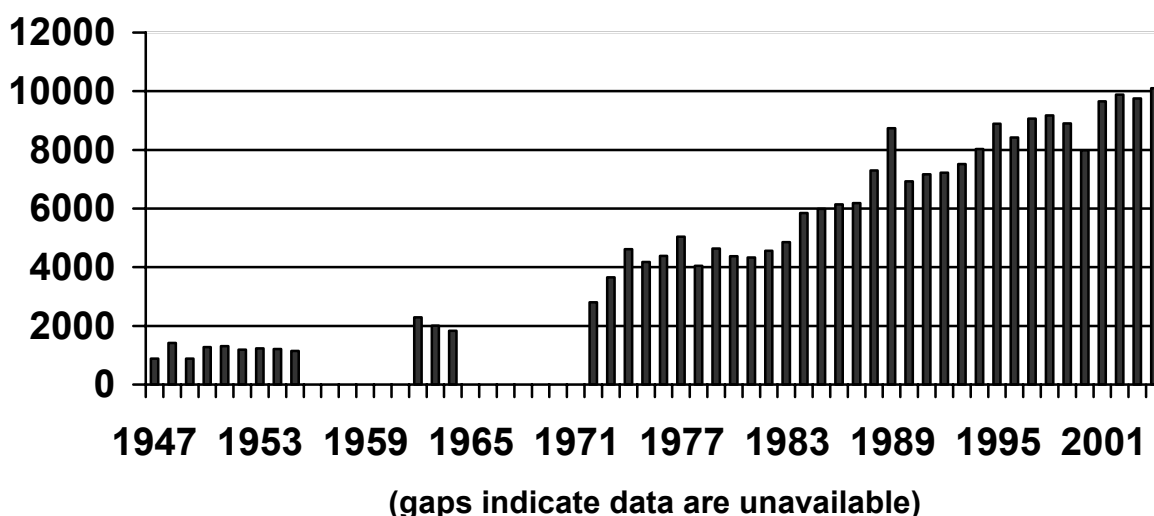
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Introduction

In 2004, use at QUBS topped the 10,000 user-day mark. After three years of flirting with this level of use, it has finally been surpassed. In 2004, user-days totaled 10,103 (user-day data are displayed in tabular form on pp. 66 and 67). Use was up by 3.5% over 2003. It was a very busy year. Indeed, the high level of use was noticed by everyone, but noted early on by QUBS staff and long-time regulars.

On average, 47 researchers (professors, graduate students, honours students and assistants) were in residence through the summer. Abstracts of 2004 research projects and documentation of the personnel involved are to be found on pages 31 through 60.

User-Days at QUBS



In teaching activities, QUBS hosted 9 modules (16 weeks worth of modules) in the Ontario Universities Program in Field Biology (OUPFB). 3.5 of these modules were presented by Queen's instructors and 6.5 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.29 - 30). In addition to the OUPFB modules, Dr. Ed Kott (Wilfrid Laurier University) brought his field course for senior undergraduates for two weeks in late summer. This is the 17th (and last) year that Dr. Kott has brought the WLU field course to QUBS. After this year, Ed will no longer co-ordinate the course, having handed this responsibility to Dr. Scott Ramsay. Jim Ludden (a QUBS alumnus) brought a midsummer field course to QUBS from College of DuPage (Glen Ellyn, Illinois).

In 2004, field trip and conference use of QUBS increased substantially (up 16%) from the levels of 2003. A summary of conference, meeting and field trip use of QUBS in 2004 appears later in this report (pp. 61-63).

Last year, Dr. Raleigh Robertson announced his plans to retire as Director of QUBS in July 2005. Raleigh has been Director since 1972. Under his direction, the field station has become a renowned, world-class facility. Congratulations, Raleigh, on a job well done. At present, discussions continue with Dr. Bruce Tufts, who has expressed interest in becoming the next Director of QUBS. Bruce is well-known for his work on fish physiology and has recently been in the news with innovative methodology for weigh-ins at fishing tournaments. Bruce was recently awarded the Canadian Society of Zoologists Public Awareness Award (2005). This award is given to a member of the Society who has made a significant contribution to public zoological education and awareness of science. Particular mention was made of Bruce's ability to reach people concerning application of best practices to conservation of fish used in sports fisheries and his outstanding commitment to public education and awareness of science.

Team Staff Award for Frank Phelan & Floyd Connor

Principal Karen R. Hitchcock presented Frank and Floyd with a Team Staff Award during the Principal's Holiday Reception in Grant Hall on 2 December. This richly deserved award was presented to recognize the many contributions that Frank and Floyd make to Queen's through their hard work and commitment to QUBS. As testimony to the extent to which their efforts are appreciated, a large number and broad array of QUBS users and friends supported this award. Following are some of the nomination materials and excerpts from letters of support:

As the team responsible for the management of QUBS, Frank Phelan and Floyd Connor, through both their joint efforts and the complementarities of their skills and personalities, excel in a broad array of tasks that contribute to the successful operation of QUBS. Their total commitment to their jobs, and above all their overriding concern with the well-being of QUBS, has contributed enormously to the growth and development of QUBS over the past 20 + years. Their contributions involve improved efficiency, ever improving 'customer' (researcher & student) service, continuous problem-solving, and most importantly, doing whatever it takes to ensure that QUBS users have a productive and enjoyable experience while working or studying at QUBS. Throughout their long involvement at QUBS, they have both undertaken an ever-growing list of responsibilities. Taking students or neighbours bird-watching or star-gazing, or helping to find a particular study site or study organism is not part of their job description, but it certainly contributes to the experience at QUBS, and hence to Queen's reputation for operating a world-class field station.



Frank Phelan, Dr. Raleigh Robertson and Floyd Connor at Staff Award Ceremony at Grant Hall

The diversity and range of their involvement illustrates the complexity and enormity of the contributions that we teachers and researchers, both from Queen's and from a number of other institutions, have come to expect from Frank and Floyd when we conduct research, or teach courses at QUBS. Most of these tasks are well beyond what would be expected from manager positions. Yet Frank and Floyd make all of these work contributions, and more, too numerous to mention, with conscientious concern for students and researchers who use the Station. Both Frank and Floyd believe strongly in the "mission" of the field station, which is to provide a first-class facility for research and teaching in a broad array of disciplines under the umbrella of field biology. Because of their strong commitment, they work tirelessly at whatever it takes to make QUBS fulfill this mission.

The numerous (16!) letters, most with multiple signatures, in support of this nomination speak volumes about the extent and breadth of contributions made by Frank and Floyd that go well beyond their normal job expectations. For example, within Queen's, faculty, grad students and undergrad students appreciate what Frank and Floyd contribute to both facilities and programs:

Mel Robertson, Head, Dept. Biology "Keeping the field station operating smoothly requires total commitment, extending long past normal business hours, and a diverse array of skills. Frank and Floyd both live on site throughout the year and, during the field season especially, this means that their jobs take over their lives for weeks at a time. They are both heavily involved in teaching, research and service activities of the field station as well interacting with, and providing information to the general public."

Queen's Faculty in their role as researchers (Laurene Ratcliffe et al.) "As faculty, we have come to take it for granted that we and our students can devote 100% of our time and energy to data collection - a tremendous advantage during short, intense field seasons. This is a true luxury, as many of our colleagues elsewhere must spend valuable time keeping themselves fed and housed. This "QUBS advantage" comes about only because Frank and Floyd are wizards at organizing clean accommodation and high quality dining fare, all at a very reasonable cost. They deftly manage a small but dedicated staff, and never demur from a "hands-on" approach when necessary, whether that involves barbecuing for a special dinner, or unplugging blocked pipes."

Queen's Faculty in their role as teachers (Brian Cumming et al.) "We cannot say enough good things about Frank and Floyd. They both are not only managers of QUBS; they are also researchers, facilitators and teachers, as well as planners, builders, caretakers, not to mention custodians. Without them, QUBS would not be one of the best field stations in North America."

Adele Crowder (QUBS Naturalist Workshops) "Frank and Floyd are both considerate and kind, their patience with slow learners is enviable - and they are fun to work with."

Allen Keast (Prof. Emeritus & long-term QUBS user) "...the skill and dedication of Frank and Floyd is so basic that the complex unit works with complete efficiency."

Queen's grad students (Dan Mennill et al.) "As a student of ornithology who wakes up early to study the dawn behaviour of birds, I know that Frank and Floyd are often the first people awake, ensuring that the basic services at QUBS are running smoothly while most people are still in bed. ...Whether interacting directly with graduate student projects, maintaining the basic services at QUBS, or fostering a friendly and productive working environment, this team goes far beyond the call of duty."

Queen's Undergrad Students (Lauren Reed et al.) "By living on site, Frank and Floyd made themselves completely accessible as resources. They have a vast knowledge of the habitats surrounding QUBS, and they were helpful in suggesting study sites for our projects."

Queen's Faculty of Education (Diane M. Lawrence) "All outings to QUBS whether as a student, organizer, or instructor have been highly successful due in no small part to the efforts of Frank and Floyd..... I don't think Frank and Floyd can know how very valuable and far reaching seeing this kind of attitude can be for would-be teachers who, when recognizing it, can begin to hope they will inspire their future students in the same way."

The team efforts of Frank and Floyd are also appreciated by many researchers and other users from outside of Queen's. For example:

Gabriel Blouin-Demers (U. of Ottawa researcher) "The primary reason why I chose to use QUBS for my work is because of the stimulating research atmosphere. Frank and Floyd contribute directly to fostering this positive atmosphere."

Marvin Gunderman (McMaster University field course instructor) "I would like to stress how the efficiency and personal attention to detail by both Frank and Floyd has resulted in glowing feedback by my students and me."

Bruce Smith & Kit Muma (Ithaca College, long-term research users) "Frank and Floyd work together in the physical maintenance and building of the infrastructure at QUBS. Many of the buildings have been built from scratch by Frank and Floyd. Often they are required to improvise in solving problems that arise thus minimizing the cost and maximizing the return on their limited budget."

Ed Kott (Wilfred Laurier University - field course leader) "It is because of Frank and Floyd that I look forward to bringing our students every summer to the station for their field studies."

James Fullard (U. of Toronto, long-term research user) "After my 25 years of working at QUBS each summer I can attest to the fact that these two people --- have turned QUBS from mere sheds in the woods to a state of the art research establishment that I recommend to my international colleagues as a place to do their studies."

Friends of Opinicon "As the everyday 'face' of QUBS, to our group Frank and Floyd present a relaxed and seamless team, patient and always ready to answer our questions, and with a curiosity and a love of learning that is contagious."

Lois Robertson (Director's wife) "Wives of Professors who had attended events at the station such as an Open House or Departmental Picnic ask if the two men are still at the station and how they appreciated the attention their questions received."

The positive impact of the efforts of Frank and Floyd in their effective running of QUBS is felt and appreciated by a very broad array of user groups, as outlined above. These user groups include Queen's faculty members in their multiple roles as researchers, teachers, and grad student mentors. They include Queen's graduate and undergraduate students, whether conducting research or taking field courses. They include the Queen's Faculty of Education. They extend to many faculty and students from other universities both from Canada and many other countries, which contributes to Queen's national and international reputation. And, the impact extends to the general public, whether through their experience at the QUBS annual Open House, or through seminars and hikes enjoyed by the "Friends of Opinicon."

As further evidence of the breadth of impact beyond Queen's that is made by Frank's and Floyd's contributions in their capacity as managers, teachers and research facilitators, letters in support of this nomination come from a department head (Brock Fenton) at University of Western Ontario, a research team (Bruce Smith & Kit Muma) from Ithaca College, a young researcher (Gabriel Blouin-Demers) and his lab group at University of Ottawa, a Professor (James Fullard) from University of Toronto who has conducted his research and grad training at QUBS since 1975, a field course instructor (Marvin Gunderman) from McMaster University, a professor (Ed Kott) from Wilfred Laurier University who uses QUBS as a site for their 4th year biology class field course, a group of friends and neighbours of QUBS -the "Friends of Opinicon", and the Director's wife (Lois Robertson), who shares the perspective of the long-lasting impact of QUBS that she experiences from contacts with former students. This list, had I asked them to contribute, I am confident could also have included equally enthusiastic letters from Dr. Mark Forbes and his students at Carleton University, Drs. Brian Neff and Scott MacDougall-Schackleton and their respective students at University of Western Ontario, Dr. Dave Philipp and his students from the Illinois Natural History Survey (Univ. Illinois), Dr. Patrick Weatherhead from Univ. Illinois, Dr. Steve Cooke, UBC, and Dr. Jan Lifjeld and his students, University of Oslo, Norway. The nature of the impact is quite consistent throughout, being that Frank and Floyd make QUBS, with its facilities, accommodations, meals, logistical support, and generally supportive environment throughout, a productive and enjoyable environment in which to study, to work and to learn.

Mel Robertson, Head, Department of Biology, nicely captures the essence of this team: "It needs to be stressed that this is a team, often referred to as the singular entity "Frank 'n Floyd", that runs the field station. On a particular busy day, either of them may be called upon to teach undergraduates, repair a boat engine, advise a visiting researcher with their unique knowledge of the area, help collect data, show a group of visitors around, manage the budget, haul the trash and a host of other unpredictable jobs. I can think of no other comparable job on campus and there is no doubt that our field activities (undergraduate, graduate, faculty and outreach) would not be the success they are today without this dedicated and long-serving team."

As Director of QUBS, I have relied very heavily on Frank and Floyd for the 20+ years they have worked as a team. Between them, with their similar work ethic and total commitment to the job, with many common yet other complementary skills, interests, and expertise, they have proven to be very successful in the day-to-day operations of the station. As a "team", they are certainly more than the sum of the parts. Neither could do the job alone, but between them, they have produced a synergistic management style that contributes greatly to the success of QUBS.

Dr. M. Brock Fenton, Chair of Biology at University of Western Ontario - a long term user of QUBS for both teaching and research in his special field of bat biology, also emphasizes the effectiveness of Frank and Floyd as a team: "I find it impossible not to think of Floyd and Frank as the very essence of the Biology Station. In my view the Queen's University Biology Station at Chaffey's Locks is one of the most effective operations I have ever seen anywhere. Although I have worked at field stations from Papua New Guinea to Zimbabwe, Ivory Coast to Costa Rica

and Brazil...none of them comes even close to the operation at QUBS. I think that it's Frank and Floyd that are the glue that holds it together, the lubricant that keeps it working."

As the nominator of Frank and Floyd for this team award, my task was easy - everyone I contacted happily responded with an enthusiastic letter of support. I am delighted that the awards committee and the Principal have recognized the value of this team through presentation of this award.

Raleigh J. Robertson
Director, QUBS

Herzberg Gold Medal awarded to Dr. John Smol

In fall of 2004, Dr. John Smol received the prestigious NSERC Gerhard Herzberg Canada Gold Medal for Science and Engineering.

(excerpt from NSERC's Herzberg Medal Current Winner Page - http://www.nserc.ca/award_e.asp?nav=herzberg&ibi=current). During the past 20 years, Dr. Smol has been a leader in the international rise of paleolimnology from a backwater discipline to a dynamic, scientific mini-powerhouse. Paleolimnology is the reconstruction of lake histories based on sediment cores taken from their bottoms.

Along with groundbreaking research that includes pioneering the study of arctic lakes, Dr. Smol has been instrumental in creating a rigorous educational, institutional and policy framework for the science. He's the founder and co-director of Queen's University's Paleoeological Environmental Assessment and Research Lab (PEARL), considered to be one of the world's premier paleolimnology training grounds. Dr. Smol has written or co-authored a literal library of articles and books on the subject, and along with colleagues has developed numerous now-standard paleolimnology techniques.

Lake sediments are an "ecosystem's memory," says Dr. Smol. The sediment is full of telltale dead organisms, especially two groups of single-celled algae called diatoms and chrysophytes, which form a layered archive of a lake's past. The top 15 centimetres of a lakebed in Ontario's Algonquin Park, for example, catalogue about 200 years of lake life. Core down five metres and you gain a detailed record of the past 12,000 years.

Dr. Smol and his numerous graduate and postdoctoral students and colleagues have shown that these microscopic algae in lake sediments can be used as sensitive historical bioindicators to study almost any environmental issue.

They've used paleolimnology to explore issues ranging from population changes in Pacific sockeye salmon during the past 2000 years, to the frequency of drought in central and western Canada, to the history of water quality in Ontario's cottage-country lakes. This information is critical to decision makers such as fisheries managers and land-use planners, and increasingly to other scientists as well.

Dr. Smol and the University of Toronto's Dr. Marianne Douglas recently worked with a team of archaeologists to document the ecological impact of 12th century Inuit Thule whalers on an Arctic lake.

Binding all this together is Dr. Smol's contagious enthusiasm for making it clear that old mud can help clear the waters when it comes to present-day environmental issues.

"Most environmental assessments today are based on three years or less of information. That's not an appropriate time scale for issues such as acid rain or global warming," says Dr. Smol.

In the 1980s, Dr. Smol's research in Adirondack and Sudbury-area lakes used the 200-year record of diatoms and chrysophytes to reconstruct the changes in lake ecology due to increasing levels of acidity, thereby sealing the case that sulphur-spewing industrial smoke stacks were indeed the lake killers.

"Acid rain pushed paleolimnology into the headlines. I think paleolimnology is an excellent example of how artificial or temporary the boundary is between basic or 'curiosity-based research' and applied research," says Dr. Smol.

"When I was hired at Queen's in the mid-1980s, a major criticism of paleolimnology was that it was totally esoteric. Then, all of a sudden, people realized they needed historical perspectives to answer questions such as 'Have lakes changed as a result of human activities?' Suddenly, in the blink of an eye, my research program switched from being classified as totally esoteric to being a rigorous science with day-to-day application by watershed managers, and seen as key to research on issues such as climate change."

Dr. Laurene Ratcliffe appointed Associate Dean

As this report was being prepared, it was announced that Dr. Laurene Ratcliffe has been appointed Associate Dean of Arts and Science starting July 2005. Congratulations, Laurene. Her bailiwick has not yet been announced.

Dr. Raleigh Robertson honoured by Queen's Senate

On January 27, 2005, Dr. Raleigh Robertson received the T. Geoffrey Flynn Advancement Champion Award from Queen's Senate. This award was in recognition of Raleigh's fundraising efforts over many years. Notable among these efforts are the Baillie Family Chair in Conservation Biology, the Queen's Land Trust, the Alexander and Cora Munn Summer Research Award, the Massassauga Property and the William C. Brown Research Fund. As well as these major achievements, he has been tireless in community outreach activities on a regular basis at QUBS.

Visiting Field Scientist Program

Our Visiting Field Scientist for 2004, was Dr. Steven Cooke from the Centre for Applied Conservation Research, Department of Forest Sciences, University of British Columbia

Through support of QUBS Director Raleigh Robertson from the William C. Brown Research Fund, I was provided with funds to offset the costs of room and board for a one-month period in the spring of 2004. A Killam Fellowship through the University of British Columbia provided additional travel support. As the 2004 Visiting Scientist, my role was to exchange information and ideas with other researchers at QUBS. This was accomplished through informal meetings and interaction with students, staff, and faculty and two research seminars. In addition, I was to focus my efforts on further developing the Warner Lake Ecological Observatory through interaction with researchers and Lotek Wireless Inc. While at the station, several meetings were held to discuss the whole-lake telemetry array. I participated in these meetings and served as a link between Lotek Wireless Inc. and the research community. From the meetings and my time spent at QUBS we developed a number of funding initiatives, outreach activities, and novel research objectives.

I also worked closely with a M.Sc. student from the University of Illinois (Kyle Hanson) and his advisor (Dr. David Philipp) in refining research questions and analyses associated with the winter biology of largemouth bass. Based on the time spent at QUBS in 2004 I have been able to produce several publications relevant to the Warner Lake Ecological Observatory. As much of my Ph.D. work was conducted at QUBS, I was also able to maintain several other aspects of my research programme that I anticipate will continue into the future (i.e., catch-and-release research, costs of parental care).

I wish to acknowledge the entire QUBS community for the enriching experience and especially the QUBS Staff for providing me with financial support. I also thank my Faculty Associates at UBC for supporting my research programme (Drs. Scott Hinch, Tony Farrell, and Mike Healey).

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

Presentations at QUBS as part of Visiting Scientist program:

1. The physiology-conservation interface.
2. Premature migration and associated mortality of late run sockeye salmon: a mechanistic approach to understanding a complex conservation and fisheries management crisis.

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.

In 2004, the Board of Directors of the Thousand Islands - Frontenac Arch Biosphere Reserve used the facilities at QUBS as a meeting site. Currently, QUBS, through Caleb Hasler, is developing a poster which outlines the role of the field station and its importance within the Biosphere Reserve.

MAJOR GIFTS

Baillie Family Chair in Conservation Biology

The Baillie Family Chair in Conservation Biology, an endowed chair funded by a generous gift from Charles and Marilyn Baillie, is linked permanently with the Queen's University Biological Station (QUBS). Its purpose is to strengthen research in conservation and biodiversity and to augment and reinforce teaching programs at the graduate and undergraduate levels in the Department of Biology.

As current Chairholder, I try to foster both research and teaching in conservation biology. Our research programs on both Cerulean Warblers and Golden-winged Warblers address issues of conservation concern. They also provide an important training milieu for both graduate and undergraduate students. At QUBS, we also foster many other research programs that have a conservation component and we work to ensure that our research and teaching environment is conducive to these types of study. Through our field course program, including the module I teach on "Behavioural Ecology and Conservation Biology of Birds", we offer undergraduates firsthand experience in conservation biology. Finally, through our outreach and seminar programs we also try to foster conservation awareness in the local community. As a measure of success of these endeavours, the recent donations of land encompassing natural habitats, most notably, the Boston Wildlands and the Massassauga Road Conservation Area, have added considerably to the conservation presence of QUBS in this area by setting aside land for the compatible uses of research, teaching and conservation on undisturbed land.

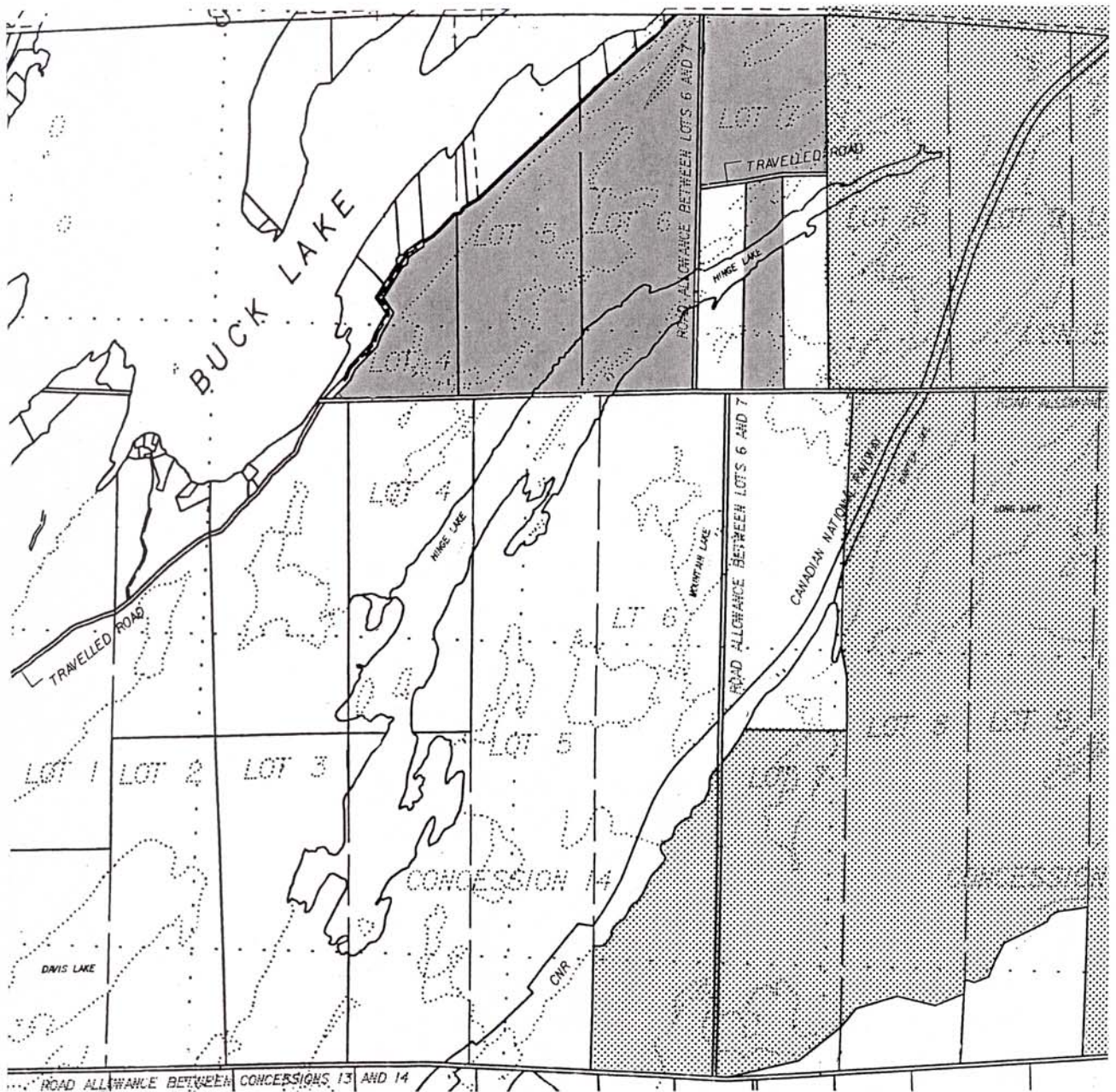
Boston Wildlands Property

Late in 2004, QUBS received a donation of property from Ralph and Elizabeth Boston. The Bostons have long been conservation-oriented in managing their property. They wished to convey the land to Queen's to ensure the long-term protection of its attributes.

The land encompasses some 102.5 hectares (153 acres), abutting the western edge of the Pangman Conservation Reserve (cf. Map, p. 8). The property includes a bit of frontage on Buck Lake, flanking the exit stream from the chain of ponds on the property. The bulk of the property fronts the old road connecting Billy Green Road to the Massassauga Road and runs eastward away from the road. The property is very rugged near the road, with long ponds and steep cliffs facing the road. Further back, the property gives way to beaver ponds, small bluffs, mixed forest and rolling hills. There is evidence of farming in the past (grassy swales) as one approaches Hinge Lake. The property includes frontage on Hinge Lake, a blackwater lake running SW-NE through the property.

Dale Kristensen did a biological resource assessment which provided necessary information for an application to Environment Canada to have the property declared "ecologically sensitive". With Dale's report, the property was, indeed, declared ecologically sensitive and qualified for gifting under the Ecogifts Program. In due course, the property was donated to the Foundation at Queen's University and with stewardship and use of the property assigned to Queen's University Biological Station.

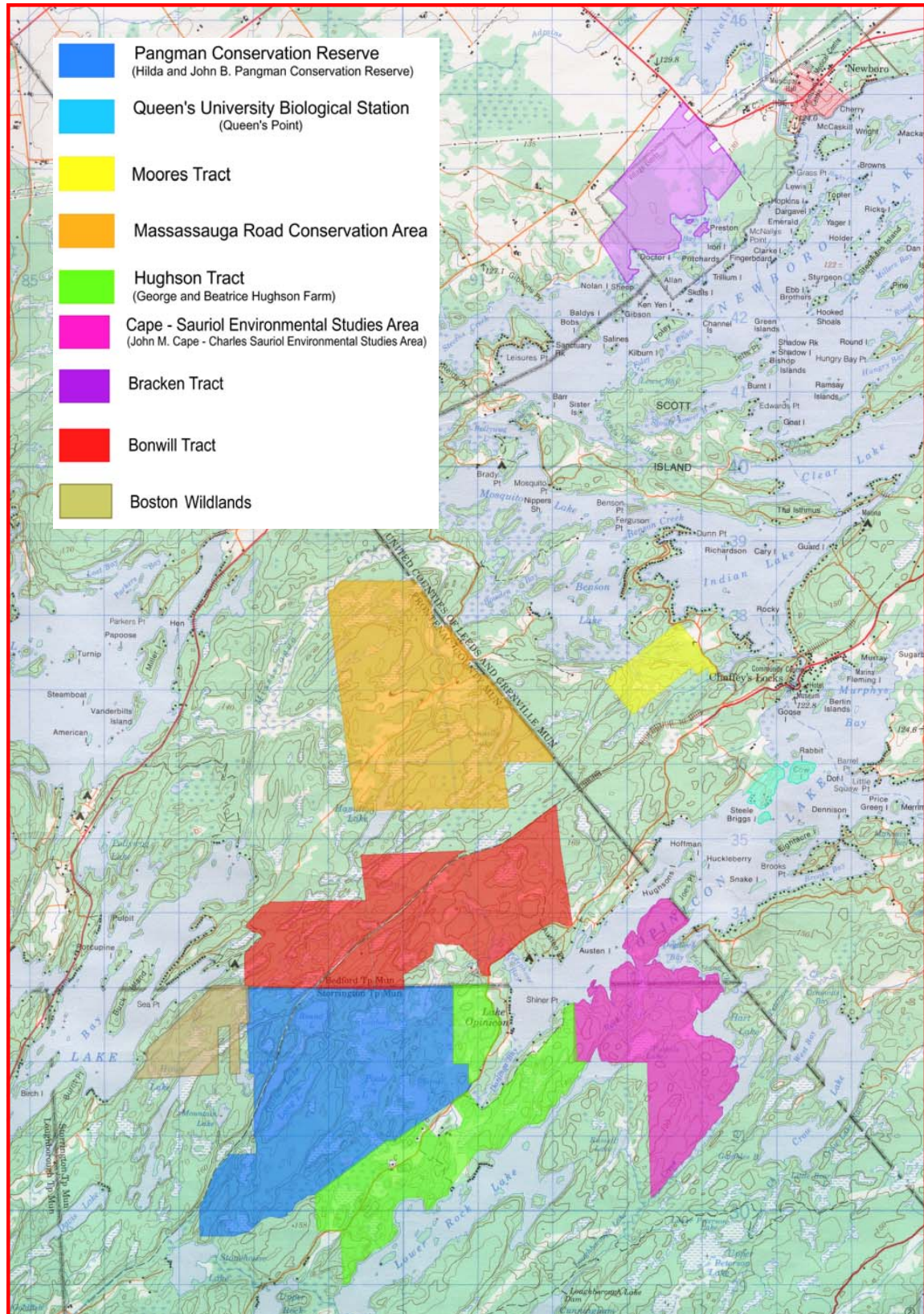
Map of Part of Concessions 14 and 15, Township of South Frontenac, Storrington Ward



Boston Wildlands



Other Queen's University Properties Nearby



Dale's resource assessment report states "this site provides good regional topographic and habitat representation for the Lower Frontenac Axis portion of the Canadian Shield (Rideau Lakes Watershed). Dominant habitat types include mature deciduous and mixed forest, palustrine and lacustrine wetlands, and exposed granitic rock bluffs. Steep ridge and valley topography, shallow soils and relatively poor drainage are hallmark features of this region". Dale's report details a long list of identified plant species on the property and the presence of six species listed by COSEWIC: Black Rat Snake (*Elaphe obsoleta*) - threatened; Milk Snake (*Lampropeltis triangulum*) - special concern; Ribbon Snake (*Thamnophis sauritus*) - special concern; Five-lined Skink (*Eumeces fasciatus*) - special concern; Common Map Turtle (*Graptemys geographica*) - special concern; Red-shouldered Hawk (*Buteo lineatus*) - special concern.

The donation of the property was completed in late November, 2004. Thank you to the Boston family for their generous gift. It is intended that the Bostons will continue to be involved with reconnaissance and conservation of the property. They should be justifiably proud of their efforts in stewardship of this interesting property.

Queen's Ecological Observatory – An Ecosystem View

Through a joint collaboration between Queen's University, biologists and industry (Lotek Wireless Inc. Newmarket Ontario) an electronic monitoring system was installed at Warner Lake in the Fall of 2003 to observe and record the fine-scale movement of instrumented fish by means of acoustic telemetry. The establishment of the Warner Lake monitoring facility (Observatory) provides complete 24 hour a day year round coverage of the entire lake. Animals can be automatically tracked in three spatial dimensions with sampling rates up to 1 second. Furthermore, the Observatory enables simultaneous monitoring of large numbers of fish at high temporal sampling rates enabling a high-resolution view into ecosystem and community dynamics.

In November 2003 a pilot study involving 22 large mouth bass instrumented with pressure-temperature sensing transmitters or tags was launched. The monitoring period of the tagged animals included the Fall-Winter (ice-in) and Winter-Spring (ice-out) seasonal transitions. The pilot study ended in April 2004 with a resultant database consisting of approximately 15 million position records. Preliminary analysis of the database has revealed new insights into large mouth bass winter ecology and animal behaviour across the three seasons monitoring took place. Correlation of animal movement with ambient water temperature (provided by the sensor tags) shows significant behaviour shifts during ice formation. Data has also revealed patterns of aggregation (schooling) and dispersion. A second tagging of large mouth bass took place in October 2004. The intent of the second study is to observe animal and community behaviour into the 2005-spawning season.

The overall objective of the observatory is to offer biologists and ecologists the ability to simultaneously observe animal relationships and interconnections across different tropic levels of the biota (the ecological view). Furthermore, the ability to generate fine-scale temporal-spatial records of animal movement presents new opportunities in such areas as energetic analysis, environmental toxicology, global warming and understanding anthropogenic influences such as catch-and-release. Future plans for the Observatory include further instrumentation of Warner lake with environmental sensors as well as radio telemetry to monitor the terrestrial-aquatic interface.

Investigators and Collaborators

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

Dr. Steven Cooke *Centre for Applied Conservation Research, Department of Forest Sciences, University of British Columbia, 2424 Main Mall, Vancouver, BC, Canada, V6T 1Z4*

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

Dr. Roly Tinline *Geographic Information Systems Laboratory, Department of Geography, Queen's University, Kingston, ON, Canada, K7L 3N6*

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



January 2004 - Floyd Connor, Cory Suski, Steve Cooke, Frank Phelan and Roly Tinline

William C. Brown Research Endowment Fund

The William C. Brown Research Endowment Fund provides a very helpful source of funds that allows QUBS to build on research programs in ecology and conservation biology. The endowment, established by a bequest from the estate of William C. Brown (B.A. 1930), provides annual income for use in research programs, facilities, equipment and teaching programs. In 2004, the fund was used to cover board and room of the GIS (Caleb) & Outreach (Liesha) SWEP students, to contribute to conservation biology research programs on both Cerulean and Golden-winged Warblers by covering QUBS costs of field assistants, for QUBS costs for a field assistant (Sylvia Wood) for the 'Norwegian' barn swallow project, and for common use efforts such as preparation of bird banding reports as well as some Warner Lake Ecological Observatory costs. The Wm. C. Brown Research Fund also covered the QUBS board and room costs of our visiting field scientist, Dr. Steven Cooke.

The Queen's Land Trust

The Queen's Land Trust grew modestly in 2004, with the balance in this flexible endowment now approaching \$200,000. Despite being a long way from our goal of \$1,000,000, it is very important to recognize that even at this level of endowment, the interest income has made it possible to cover the costs of some of the legal and appraisal fees associated with the recent donation of the Boston Wildlands. Such costs would have been impossible

to absorb within our limited operating budget, and it is increasingly difficult to obtain contingency funds from limited university budgets. As before, the Land Trust is designed to ultimately make it possible for QUBS to acquire some key parcels of land, and to provide the programs that use the land for teaching and research and the stewardship to protect the land in a conservation reserve manner encompassing some 25 km² of natural habitat.

Dr. Allen Keast

Once again, Dr. Allen Keast made a kind donation to the QUBS Trust, which allows us to improve both our facilities and our programs. Allen's support, both financially and intellectually, continues to make an important contribution to our efforts at QUBS. This support is greatly appreciated.

Gifts and Estate Planning and Annual Giving

Private donations have played a large role in the expansion and enrichment of programs and facilities at QUBS, and we anticipate the need for an even larger role for these sources of funds in the future. With a combination of the Queen's University Biological Station Trust, and the Queen's Land Trust, we are positioned to take advantage of both donations and bequests. For donors wanting to contribute to either programs or facilities, the QUBS Trust allows us to use funds for on-going projects, and to accumulate funds over several years for larger projects. The Queen's Land Trust, which is for the purposes of land acquisition and stewardship, is set up as a flexible endowment that allows us income on the endowment, but with the provision that the capital could be used if necessary to acquire a strategic parcel of land.

We encourage friends and alumni of QUBS to consider planning a gift or bequest to QUBS as a way to ensure a bright future for field studies in biology. Please note that when the Queen's Annual Giving Campaign contacts you, if you want your gift to be directed to QUBS, you should state that the donation should go to either the QUBS Trust (formerly the Opinicon Appeal account), or to the Queen's Land Trust.

We appreciate your support.

NSERC and Other Support

NSERC MFA Grant

2004 was the 21st year that QUBS has held a Major Facilities Access (MFA) Grant from NSERC (Natural Sciences and Engineering Research Council) (including the years of MFA's precursor, the Infrastructure Grant). 2004 was the second year of the current three-year award. A new application will have to be filed in fall of 2005 for the next round of decision-making.

The grant pays the salary of QUBS Assistant Manager (Floyd Connor) and half of the Maintenance Assistant (Roger Green) salary and benefits. As of last year, the Assistant Manager's benefits are paid by Queen's. In addition to salary and benefits, the grant also contributes to the cost of shared services (e.g. electricity) and infrastructure. In 2004, the MFA grant paid for the installation of high-speed wireless service at QUBS. This vital link to the outside world is appreciated by every user of QUBS and enables efficient data transfer and communications at the field station.

The MFA award recognizes the productivity and excellence of a multi-university initiative. With researchers coming to QUBS from many Canadian, American and International universities, an atmosphere of inquiry and interaction is created, which affects all who use QUBS. This atmosphere leads to creative discussion which, in turn, challenges users to be innovative in quality research.

CFI Grant to Smol and Cumming

Final touches to the storage building were made in 2004. Fill and gravel were added to the road and access pad in front of the building and a patio stone entryway created at the service door.

The building is a 32' x 50' storage building, largely funded by the Canada Foundation for Innovation grant to Drs. John Smol and Brian Cumming, with contributions from the Biology Department, School of Environmental Studies and the Biological Station.

Special Initiative Funding from Arts and Science

With Renovations and Alterations funding unavailable in 2004, the Associate Dean of Arts and Science (Dr. Alistair MacLean) approved funding for repairs to the Boathouse at QUBS. A plan to stabilize the structure, repair crumbling dockwork and perform a facelift on the complete exterior was developed. Special funding was promised to cover the structural work (\$38,672.00).

Planning for this undertaking was started in 2002, with site inspections by Parks Canada and the shoreline works review team. Ultimately, an environmentally friendly plan was adopted which provides for rip-rap sloping into the water and capped by a concrete or wooden deck supported on steel pilings. Steel sheet piling or vertical concrete walls are no longer acceptable for waterfront buildings.

Robb McManus (Portland) was contracted to do the work in three phases.

Phase 1 - replace the rotting sills with steel tubing and provide concrete patching where the foundation had cracked badly (south wall and central floor).

Phase 2 - replace wooden support beams with steel beams and jackposts - 2 longitudinal steel beams connecting to the steel sills and otherwise resting on jackposts.

Phase 3 - break edges of existing concrete docks to provide a rip-rap slope entering the water, drive steel pilings to support a steel framework overtop of which cedar decking is to be built

Phases 1 and 2 were completed by end of March, 2004. Initial work on Phase 3 was undertaken in late fall of 2004, with all work to be completed by spring of 2005.

Associated with this work, QUBS undertook a number of projects to complete the facelift of the building. This work will be addressed in detail under the Renovations and Additions section later in this report.

Suffice it to say that the building has been completely renovated and looks very good, indeed. The concerns about stability and safety of our old Boathouse and signature building have been addressed. We thank the Dean's office for their support of this project.

SCHOLARSHIPS AND BURSARIES

Wes and Dorletta Curran Scholarship

Emily Darling received the Curran Scholarship in 2004. Emily's project, *On the importance of being separated: herkogamy and variation in natural populations of flowering plants* for her B.Sc. Honours Thesis, supervised by Chris Eckert, is described elsewhere in this report. As to the value of the Curran Scholarship in supporting this project, Emily is very positive, "This summer I had the opportunity to pursue independent research at the Queen's University Biological Station thanks to the Curran family award. This award provided me with a fantastic opportunity to engage in field research, an experience I would not have had otherwise. Not only did the Curran award encourage me to pursue biological research during the summer, but it also introduced me to a fantastic group of like-minded students, researchers, and staff at the Station. The chance to conduct research in a natural setting is unmatched by laboratory or greenhouse experience and the Curran award has encouraged me to pursue a field-oriented research study in graduate school. I am deeply grateful for the opportunities provided to me by the Curran family and QUBS. I hope this support is able to continue in order to benefit future Queen's biology students."

Alexander and Cora Munn Summer Research Award

Erik Coleman was the first recipient of the Alexander and Cora Munn Summer Research Award. This award, established as an endowed fund by Alexander and Cora Munn, is to help provide an opportunity 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.

Erik did earlier studies at Guelph some years ago. He then took time off to pursue other interests that took him to a variety of places and resulted in, among other experiences, a diploma from Arctic College and several years working as a conservation officer in Taloyoak, a small hamlet in Nunavut. In 2000, he returned to Kingston, his hometown, and was admitted to Queen's where he is now completing his honours thesis under the supervision of Dr. Paul Grogan.

Over the previous 2 summers, Erik worked at QUBS for Dr. Laurene Ratcliffe on a chickadee study collecting breeding data. This gave him a taste for birding, and a chance to develop a better awareness of the forests that he had been walking through for many years.

During the summer of 2004, with the help of the Munn Award, Erik joined the cerulean warbler project which was expanded from the well-studied Bedford Mills Road study site to survey mature forest patches in neighbouring counties in an effort to determine the minimum area of mature forest required for breeding. He also worked with Dr. Paul Grogan on a study of forest soils.

As Erik pointed out in a letter to Mr. and Mrs. Munn, the Cerulean Warbler "is a challenging and beautiful bird to study, and it is thought to be suffering from habitat depletion. Since habitat depletion seems to be a common theme for many species my interests have recently shifted to forest ecology. I will be spending the last half of my summer collecting data for my honours thesis, to be supervised by Dr. Paul Grogan. There has been some indication that sugar maples are associated with high levels of nitrate leaching from forest soils, thus depleting the soil nitrogen pool, and contributing to acidification and eutrophication in lakes. We hope to see if this trend is true in Ontario, and if it applies to any other dominant tree species.

"As you will notice, I am entering my fifth year as an undergrad (not counting anything prior to 2000!). I took on a reduced course load last year because my wife and I had our first child last August. Our daughter Sadie Claire is 9 months old, very healthy and a wonderful treat for us. It is for this reason that I am most thankful for the award you have provided. Life has been and will continue to be very tight financially for us, but we believe deeply in both pursuing our own educational needs, and providing a stable and caring home for our daughter. Gifts such as yours go a very long way towards making our goals attainable. Thank you for your generosity and thoughtfulness."

Pearl E. Williams and Llewellyn Hillis Fund

No events or projects were hosted in 2004 as it was decided to allow the income to 'grow' for a year in order to make a significant contribution through this fund in 2005.

QUBS Outreach Programs

Seminars

Planning the seminar program was a joint effort between Frank, Liesha Mayo-Bruinsma and Shannon McCorquodale. A brainstorming session early in the year yielded many potential topics and speakers. Liesha worked to fill out the program. Once the schedule had been planned, Shannon, Sue MacLachrie and Kathy Wirsig helped circulate the information to the local community. Thanks to all who helped in the process. The full list of speakers and topics is found later in this report (pp. 64 - 65).

Early in the summer season, the seminar program is dominated by research activities of QUBS regulars and visitors. Some sessions are meant as introduction to personnel and topics, sprinkled with seminars from QUBS Visiting Scientist and other visiting educators and researchers. The seminars stimulate interaction between QUBS regulars and lead to informal discussions and exchange of ideas. As the summer progresses, topics shift to appeal to a wider audience of friends and neighbours, visitors to the area and the Friends of Opinicon. Thus, the seminar

series has become a major part of the outreach program at QUBS. The seminar room is regularly standing room only, proof of the interest of the "locals" in biological topics and the success of the program itself.

Suggestions for speakers and topics are always welcome.

Open House

The 34th annual open house was held on Sunday July 4, 2004. Approximately 450 visitors attended. QUBS regulars offered tours of the station and displays of research projects. Those who attend find it informative and appreciate the opportunity to converse directly with field researchers and pose questions of all kinds.

The Open House is a significant outreach effort of the field station, only made possible by the efforts of the QUBS Regulars. Liesha Mayo-Bruinsma (QUBS Outreach Coordinator and Information Manager for 2004) was instrumental in helping with the logistics of planning of the event and of mounting displays. QUBS staff had the station looking very good and the kitchen produced lots of goodies for all to enjoy. Thanks to all who helped in this outreach effort, especially the Regulars who put a lot of effort into being effective ambassadors of environmental scientists, researchers, and field station personnel. Attendees learn a lot about biology and research and QUBS regulars, in turn, learn a lot about public perception and interest.

The 2004 version of the Community Newsletter (23rd edition) was distributed to some 1175 households and cottages in the Chaffey's Lock, Elgin, Perth Road, Massassauga Road and Hutchings Road area. This annual circular serves a similar purpose as the Open House, maintaining contact with the activities underway at QUBS and providing a means of outreach for those unable to attend the Open House.

Outreach activities are part of the mandate of QUBS to provide educational and research opportunities for a broad user base. Outreach activities are key to the continued success of the field station. Close and friendly contact with neighbours enables many projects, especially when research projects or teaching activities extend beyond QUBS landholdings. Without the continuing support of the local community, opportunities at QUBS would become somewhat restricted.

QUBS Logistical Support

GIS/GPS AND SWEP

Caleb Hasler was the sole official GIS (Geographical Information Systems) and GPS (Global Positioning Systems) assistant at QUBS in 2004, jointly sponsored by Queen's SWEP (Summer Work Experience Program) and QUBS. His experience with GIS in Dr. Rowland Tinline's classes at Queen's and his enthusiasm for GIS and the outdoors enabled him to expand and upgrade several projects that were already under way, and to contribute to several new ones. Caleb was instrumental in managing and updating the QUBS "Quick Maps", a series of maps of the QUBS property based primarily on GPS work done here, and designed for quick and easy printing to facilitate property access for researchers and visitors. Sample copies are now in colour and mounted on the wall in the QUBS computer room, though at the end of 2004 there is a persistent "glitch" in their software that is temporarily hindering their use.

Caleb participated in several GPS projects for QUBS. He was closely involved with the Lotek (see elsewhere in this report) bass research at Warner Lake. He and others from the Queen's University GIS Lab surveyed the hydrophone array there and were able accurately to map it using DGPS and a laser-based "total station". Caleb, with Gregory Bulté of University of Ottawa, also completed the formidable task of mapping the depth contours of Opinicon Lake. Caleb's last duties at the station were surveying possible line-of-sight paths for an intended wireless Internet connection to Chaffey's Lock (since installed), and using GPS and GIS in co-operation with Frank Phelan to produce a new and updated QUBS Property Boundaries Map for the display board in the lower hall in the QUBS Operations Centre and other communications.

Another aspect of Caleb's mandate was to work with researchers and help them incorporate GPS and GIS into their research. He worked closely with Ryan Norris in producing maps for a paper that Ryan hopes to submit for publication soon. He also produced forest coverage maps that were used by Dr. Robertson's Cerulean Warbler crew and completed GPS work for the Bass, herp, American Redstart, Golden-winged Warbler, and Barn Swallow crews.

Teaching was also an important part of Caleb's position at QUBS. His Open House display was well visited and many questions were answered. His nature photos appeared from time to time as backgrounds on QUBS

computer monitors, and one (of the old QUBS dinner bell) was featured in the Queen's promotional calendar for 2005 (check out "August", and the cover of this report). In his explanation of GIS during the Wednesday Night Seminar Series, Caleb's "Star Trek" analogy cleared up many uncertainties. He also helped with Science Discovery Camps for High School students by creating a GPS Treasure Hunt.

All-in-all, Caleb's involvement with QUBS in 2004 was both diverse and intense. His assistance was effective and cheerfully given. As this report goes to press, we are hopeful that he will be back at QUBS in 2005, beginning a Master's degree that combines biology and GIS.

Outreach Coordinator/Information Manager and SWEP

Liesha Mayo-Bruinsma was this summer's Outreach Coordinator and Information Manager, a position funded by Queen's SWEP (Summer Work Experience Program) and QUBS. She started out the summer by cataloguing a plethora of maps that the station had acquired. Then, a display of nature specimens was created and set up so that it was interactive and informative for the public. Wall displays were updated in the Operations Centre. Liesha sorted and filed many documents for the archive as well as completing many office-related tasks.

Liesha was instrumental in organizing and scheduling the summer seminar series. With the help of Shannon McCorquodale, seminars were advertised and the Friends of Opinicon were called to keep them informed of the scheduled seminars.

Liesha produced the annual Community newsletter which was distributed to 1175 households in the area. She was the sparkplug for the annual Open House and was available to all researchers to ensure that the day ran smoothly.

A project of particular interest was starting to develop the Boardwalk Trail. Liesha undertook to tidy the trail to the Cow Island Boardwalk and then to clear the trail from the Boardwalk to the Aviary Field. Liesha also gathered material for a pamphlet for the interpretive nature trail along both these paths. This project will be completed in 2005 by the next OC/IM.

Liesha assisted with planning and running a varied program of activities throughout the summer. Some of these were a GPS treasure hunt for high school students set up by Caleb Hasler, helping with fish ecology sampling for Science Discovery field trips run by Frank Phelan, coordinating presentations by researchers for field naturalists groups and a day of activities for a group of high school teachers learning to teach biology.. Liesha was on hand to help with many varying public relations initiatives, everything from talking to cottagers and providing information to organizing outings with researchers for local journalists.

Liesha organized the QUBS library holdings and also designed bookplates for these holdings.

With the use of the station's new digital camera, Liesha was able to get a collection of candid shots of researchers in the field and QUBS environment. Some were used in a display on QUBS in the Biosciences complex and in the Community Newsletter. A series of shots were compiled into a preliminary promotional video for QUBS that attempts to show who we are and what we do.

Acknowledgements

The Biology Station has become a very busy place, with a multifaceted role to play in teaching, research, conservation and outreach. It would have been impossible to do so much without the dedication of our capable and dedicated staff. Thanks to Roger (Rod) Green, our Maintenance Assistant and our Food Service Staff - Marg Phelan, Cheryl MacDonald, Veronika Jaspers-Fayer and Karen Smith. Thank you also to Nynke Mayo-Bruinsma for her assistance with associated kitchen duties during busy times. Thanks also to QUBS alumnus Morgan Hull for his able help with Boathouse renovations in late summer.

During the Annual Dinner, July 2, Floyd Connor was surprised and very honoured when Beth Clare, assisted by Kit Muma, presented him with a T-shirt to acknowledge his 20 years as Assistant Manager at QUBS. The shirt bears many signatures of QUBS residents and associated friends, an excellent memento much appreciated!

QUBS Properties

Hughson Farm

In 2004, The Hughson Farm was used for studies of Tree Swallows, Golden-winged Warblers, Blue-winged Warblers, Cerulean Warblers, Black Rat Snakes, Eastern Milksnakes, Painted Turtles, Map Turtles, Damselflies, Dragonflies, Hoverflies, Water Mites, Largemouth Bass, Smallmouth Bass, Bluegill, Pumpkinseed Sunfish, Plant Competition, Old Field Succession, the possible effects of bismuth on forests and wetlands, dendrochemistry, metal and isotopes and acidity and nitrogen cycling.

The various bird box grids were again used by Dr. Raleigh Robertson and his students in 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 was intensively used for plant competition studies.

Haying of the open fields was done by Bob Butterill and Roger Green in 2004.

Late in 2004, a deal was struck with local contractor Derek Rab to remove the New Barn. The foundation of the barn has been slowly deteriorating and the barn has now become a hazard. The barn should soon be removed. In its place, a memorial to George and Bea Hughson (and the New Barn) is being considered.

Bonwill Tract

The Bonwill Tract was used in studies of American Redstarts, Tree Swallows, Golden-winged Warblers, Blue-winged Warblers, Cerulean Warblers, Black Rat Snakes, Eastern Milksnakes, Painted Turtles, Map Turtles, Damselflies, Dragonflies, Hoverflies, Water Mites and nitrogen cycling in 2004.

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, north and east of the Wire Fence Field.

Haying of the open fields was done by Bob Butterill and Roger Green in 2004.

John M. Cape - Charles Sauriol Environmental Studies Area

The Cape-Sauriol Tract was used for studies of Black Rat Snakes, Eastern Milksnakes, Map Turtles, Largemouth Bass, Smallmouth Bass, Bluegill and Pumpkinseed Sunfish in 2004.

Hilda and John B. Pangman Conservation Reserve

In 2004, the Pangman Reserve was used in studies of Cerulean Warblers, Golden-winged Warblers, Blue-winged Warblers, American Redstarts, Black Rat Snakes, Eastern Milksnakes, Largemouth Bass, Northern Pike, Bluegill, Dragonflies, Damselflies, Hoverflies, Water Mites, Zooplankton and nitrogen cycling.

In Warner Lake, the Lotek Ecological Observatory (see pages 10 - 11) was used to monitor 3D locations of Largemouth Bass. 23 more acoustic tags were implanted in bass in fall. The hydroacoustic array is being used to study the seasonal movements of bass in this small lake. Transmitters enable constant 3D positioning along with pressure (depth) and temperature data (see Dr. Philipp's research summary for further information).

Northern Pike in Lindsay and Poole Lakes have been implanted with PIT (Passive Integrated Transponder) tags as part of a study on movements and population biology of pike.

Signs were erected at Warner (near Lotek outpost and at end of trail from Lindsay Lake Road), Lindsay (at landing at Lindsay Lake and at the channel between Poole and Lindsay) and Poole Lakes (along trail to landing from Cemetery Field and at the landing off the Rideau Trail at west side of lake) declaring them as research lakes - no fishing. Efforts were made (locks, chains) to control access to the boats on the lakes and to prevent angling.

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 used in studies of Golden-winged Warblers, Brown-headed Cowbirds and Song Sparrows in 2004.

In fall, the property was intensively used by students from Geology 221 (Geological Field Methods). Doug Archibald had the students lay out baselines and pickets and, working in groups, paced and compassed on perpendicular lines. The purpose of the field work was to determine the stratigraphy of the surficial sediments (lacustrine clay and/or sand over till in most places) on the property using soil augers. In addition, a magnetometer survey was done on the baselines to determine the location of the buried contact 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 a very successful iron (magnetite) mine.

Maurice and Wayne Hutchings are permitted to graze cattle on this tract in exchange for keeping an eye on the property. Ecologically, the cattle will help keep some of the property in early successional stages. The Hutchings have been very cooperative, managing cattle so as not to interfere with research efforts.

Moores Tract

In 2004, the Moores Tract was used in studies of Black Rat Snakes, Spring Peepers, Bullfrogs, Damselflies and Water Mites.

Crabbe Property

The Crabbe House was effectively used as a site to house Brown-headed Cowbirds in 2004. Dr. D. Sherry is studying the behaviour and physiology of cowbirds.

An arrangement was made with Jim Hales, who lives nearby, to cut the grass around the house on a regular basis.

Massassaugua Property

In 2004, more exploratory forays through the property were made in an effort to become familiar with this new area.

The big barn was used in studies of Barn Swallows.

The arrangement for use of the barn by Michelle Cummings for horses was terminated in 2004. Ken Young continues to use the barn for cattle and hay storage. The open fields were hayed by Ken in 2004.

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

Boston Wildlands

This property came under Queen's ownership late in 2004. Ralph and Libby Boston wanted to convey this wild property to Queen's in order to preserve the property for the long term. The Bostons have long managed the property with a mind to conservation. It is our intent to build on this history toward the future.

Initial familiarization forays were made through the property throughout the year by QUBS staff and by Dr. Robertson's Conservation Biology of Birds Field Course in May as an exercise in applied conservation.

Dale Kristensen was engaged to prepare an initial inventory and assessment for Environment Canada, to serve as the basis of having the property declared ecologically sensitive.

Water samples from the major water bodies were taken and analyzed for contaminants by Queen's Analytic Services Unit during preparation of an environmental assessment of the property prior to transfer to Queen's. No problems were detected.

At present, an ongoing management agreement involving the Boston family in monitoring and managing the property is being discussed.

Queen's Point

In 2004, the islands and mainland property of Queen's Point were used in studies of Black-capped Chickadees, Barn Swallows, Tree Swallows, Golden-winged Warblers, Black Rat Snakes, Eastern Milksnakes, Map Turtles, Bats, Largemouth Bass, Smallmouth Bass, Bluegill, Pumpkinseed, Logperch, Damselflies, Dragonflies, Hoverflies, Moths, Katydid, Water Mites, Zooplankton and Mussels.

Necessary repairs were made to the boardwalk to Cow Island.

Plans for an interpretive trail to Cow Island were laid in 2004. Liesha Mayo-Bruinsma started clearing the trail and planning a section to the overlook between the Cow Island Marsh and Aviary Field. Hopefully, the trail and its interpretive stations will be finished early in 2005.

Animal Care, Safety and Training

Animal Care

In November of 2001, a specific policy on animal care for QUBS was put in place. 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.

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 1, 2004, Queen's University has adopted a new Off-Campus Activity Safety Policy which supersedes the previous Field Safety Policy. Under the new document, QUBS is deemed 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 workers and establish principles and procedures for safety in the field. Non-Queen's PIs should undertake a similar process using the material provided in the 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 the new regulations, all lab workers must have training and must renew this training each year. WHMIS certificates issued before the year 2000 are invalid - individuals must complete a the full WHMIS training program. Due to the specific content of Queen's WHMIS training sessions, WHMIS training from previous employees is not acceptable. Even office workers and others not directly working in labs must have exposure to WHMIS training. If your lab uses **any** chemicals at QUBS, it is imperative that all your lab workers have WHMIS training. Please arrange for this well before arrival at QUBS.

QUBS is not an appropriate place for extensive chemical use. Chemicals brought to QUBS must be accompanied by current MSDS (Material Safety Data Sheets)(current = less than 3 years old). Bring only small amounts of chemicals to QUBS. Discuss appropriate safe storage, handling and proper disposal with QUBS safety officer, the Manager.

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 this, via local courses or web-based training. A good place to start looking for information is the Canadian Coast Guard (<http://www.ccg-gcc.ca/>).

QUBS users who plan to use motorboats must show proof of competency before using station boats. This means that PIs should plan ahead and arrange for appropriate training for themselves, graduate students or field assistants before arrival at QUBS. During the summer, if sufficient interest is shown, an on-site course could be arranged. This has been done several times in the past. The Manager has contacts for potential instructors.

During field courses last fall, a check by the Ontario Provincial Police of our large pontoon boat revealed that Transport Canada has enacted new regulations which affect such vessels. There are only two classes of vessel: pleasure and commercial. Under the new regulations, a vessel the size of our large pontoon boat and carrying 20 or so passengers is now classed as a commercial vessel. As such, it must be piloted by a licensed captain and must undergo twice-yearly inspections by Transport Canada. The new regulations cause use of this large pontoon boat to be too restrictive for QUBS, so at present, consideration is being given to sale of the large pontoon boat and perhaps

purchasing two identical smaller pontoon boats. By rafting these together to form one large floating classroom when desired, we would comply with current regulations and still enable group study.

All-Terrain Vehicle Safety

All-terrain vehicles (ATVs) are considered research tools at QUBS. While ATVs have become useful workhorses for a variety of research applications, ATVs are expensive and potentially dangerous tools. As such, QUBS insists on all users having taken a training program. Proof of training from any established authority is acceptable. For those requiring on-site training, QUBS uses the training 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 before using any ATV on QUBS property.

Drinking Water Safety

In the aftermath of the Walkerton tragedy, 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.

The drinking water system has been inspected by a professional engineer (March 2002). Two ultraviolet light units operating in tandem treat all water coming in from the well. Water is tested weekly for microbiological parameters. A comprehensive multi-parameter test was conducted in June of 2002 and will be repeated every 5 years. As a result of a recommendation in the Engineer's Report and as a matter of due diligence, the QUBS septic system was replaced in fall of 2003. Despite having fulfilled all requirements since early in 2002, the first annual report on the QUBS drinking water system was filed in May of 2004 (first mandated report under the Act).

Sampling of QUBS drinking water and inspection of equipment occurs on a regular basis. QUBS is supplying safe drinking water to QUBS, and staff makes every effort to ensure that this continues.

Fire Safety

QUBS users may be unaware that monthly fire equipment inspections are undertaken at the first of each month. All fire extinguishers, alarms, monitors are checked in all labs and accommodations. The portable fire pump is tested and emergency procedures reviewed. Further, during the tour of extinguishers etc., all facilities are inspected for hazards. In addition, periodic tours of facilities are arranged with local firefighters to familiarize themselves with QUBS before an emergency.

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

Renovations and Additions

White House

The old entry doors on the upper level of the White House were replaced. The old door sills were rotting, the doors were uninsulated and the screen doors were sagging from use. New, insulated steel doors with a screened window were installed on both front and back upper level entries. The new doors should provide improved entryways, should be able to conserve some heat and yet provide ventilation during summer months.

A new programmable thermostat was installed along with a cage to both protect the thermostat and to prevent tampering. This is another step toward conserving energy at QUBS.

Some small, largely unnoticeable touches were done to finish the kitchen renovation undertaken in 2003. Some trim and caulking were added. Also, throughout the house, baseboards were scraped and cleaned and some floor tiles replaced as required.

Trilab

Finishing touches were done to the exterior of the Trilab, completing the facelift started in 2003. The exterior has now been completely renewed with fresh paint, new roof and window glass and trim.

Boathouse

In conjunction with the structural work undertaken through the special initiatives funding from Arts and Science (detailed elsewhere in this report), a serious exterior renewal was done. Courneya Roofing (Portland) was engaged to reshingle the roof. All of the old shingles were removed, tar paper laid down and shingles reapplied.

With the assistance of Morgan Hull (a QUBS alumnus and schoolteacher from Ottawa), QUBS staff addressed the exterior of the building. All carpenter ant damage and rot was repaired along with years of impact damage and breakage of individual boards. Fascia were replaced where required. The cables that held the sides of the building were gingerly removed and the 4x4 hardwood plates which anchored these cables on the outside of the building were removed. The cables were replaced by chains and the hardwood plates by steel plates. With adjustable eye bolts connecting the chains to the plates, the tension on the chains can be easily adjusted. The SCUBA shower room was altered, removing it from under the old beams. The room is a bit smaller now, but still well-suited to its purpose as a warm-up/change room for divers. The exterior was scraped, holes were filled and then primed then painted. The west and south sides which had become very mildewed over the years, received special attention, being first scrubbed with bleach before starting the facelift. The attic windows were removed and replaced by screened vents. This should help moderate inside temperatures during the warm seasons. All screens and frames were repaired or replaced as required. For the windows, all missing glass was replaced, reputtied and repainted. On the upper level, the windows were cut in two, with the newly formed windows hinging half up and half down. This arrangement allows easy ventilation without the hazard of an entire window being hung open overhead. A new exterior sign was done by Jim Janeway (Westport) and reinstalled.

At present, with bright newly painted walls, a new roof and signage and sharp new cedar decking, the building looks terrific. It was well worth the work, although some 400 man-hours went into the cosmetic work.

Operations Centre

New bookcases were purchased and installed in the alcove of the conference room. These are intended to hold theses and field guides and make them more accessible.

To complete the deck at the front of the building, handrails were built from steel tubing by QUBS staff. The new MIG welder came in very handy for this. The handrails are an unobtrusive design and are painted to match the trim on the building.

At the same time as the handrails, the steps to the front deck were extended and now line the niche built to accommodate the maple tree, rather than ending abruptly and recommencing on the lower part of the deck. The board and batten "fences" which screen the underside of the deck were stained to match the building. The ground around the deck was leveled and improved with a bit of topsoil and then sod was laid to provide an "instant" lawn.

All of the fir steps in the entryway were refinished, crack sealed and revarnished.

In the access hall to the dishwashing room, a new garbage/recycling centre was built. This addition is a hinged box housing receptacles for trash, compost and recyclables. With the top down, the receptacles are invisible. With the top up, assisted by a counterweighted pulley system, all receptacles are easily accessible. With the top up, the front of the box is removable, giving easy access to the wheeled receptacles. Utility shelving above this unit will complete the addition.

The dining room tables are constantly used at maximum length, with all leaves installed. Unfortunately, at full length, the outside ends had begun to droop. QUBS staff invented a support system made from tubular steel and adjustable contact points to solve this problem. The repair is invisible and removable and works well to reinforce these beautiful tables.

With the new building, many safety devices were installed. For the most part, these are necessary and effective. However, when the power goes off, the safety solenoid on the propane stove shuts off, rendering the stove inoperable. This is a major inconvenience, to say the least, during meal preparation, so some means of operating the stove during a power outage was sought. Wainick Electric (Crosby) installed an in-line plug in the kitchen to allow operation during power outages. Above the electrical panel in the kitchen, a dedicated plug was installed. If the power goes off, one removes the in-line plug and replaces it with a cord run to a generator. Then the stove can be relit with the accessory power. When main power is restored, there is no risk of backfeed since the plug can only operate on main or generator power and not both.

The old dishwasher finally failed after many years of yeoman service (originally installed in 1990). Accordingly, a new dishwasher was installed in summer.

As with any new building, one expects some quirks. A serious quirk was discovered with the roof of the operations centre during heavy rain - it leaked! After much sleuthing, it was discovered that the rain falling from the upper roof onto the lower roof was forcing up under the overlaps of the sheets of roofing. Then, the water worked its way down on the topside of the ceiling and ran down the walls, ruining the drywall and paintjob at several places

on the interior walls. Ironically, this probably would not have happened if the roof sheeting had been overlapped in the opposite direction. Anyway, Amherst Roofing (Kingston), through Eric McGinn were contracted to effect a repair. New galvalum sheets were applied overlapping the problem areas. At the same time, proper flashing and seals were installed around the vent stack above the dishwashing room. This too, leaked during heavy rain. As part of the repair, new sheets were also added flanking the front entry where falling ice and snow from the upper roof had dented the sheeting on the lower roof.

In an effort to conserve heat within the building, a winter entry portico was built. During cold weather, the main entry doors allowed a flood of cold air to enter the building every time the doors were opened. The portico creates a second door inside the main doors, serving as a bit of an airlock. The portico works well and is easily removed during warm weather. It is built using lucite greenhouse panels so as to keep heat in but not block light coming into the building. A clever system of fasteners attaches the portico to the inside walls of the building and connects the four parts of the portico itself. Stained to match the woodwork of the building, the portico looks good while doing its job.

Library

Theses and field guides were relocated to the conference room of the operations centre. The map cabinet was moved to the GPS room of the lodge. Extraneous field gear was moved to the storage loft of the new storage building. These changes made the space inside the library much less cluttered and enabled more flexibility in use.

The Local Area Network cabling was routed in surface runway to both levels, library and the bird lab in the lower level. This greatly organizes the wire snarl and improves the overall appearance.

In fall, the library was reroofed. The old shingles were removed and replaced. This was a timely venture as several places were discovered where water was beginning to infiltrate the old shingles. The library has long suffered from its location on a side hill. Surface water constantly runs downslope against the building and water from the west side also falls next to the building. Eventually, some of this water finds its way through the basement wall and into the bird lab. Despite many attempts at improving drainage and sealing the walls inside and out, this has been a perpetual problem. During reroofing, several changes were made to help with the water problem. First, a cricket was made built over the entrance door. This false peak keeps water from falling directly on the entrance deck (and anyone entering) and diverts the water along a valley to each side. Starting at the end of each valley eavestrough was installed along the roof. Water collected by the eavestrough is conducted down and out away from the building on each side. Thus, all of the water falling on the west side of the roof is channeled away from the building. Time will tell whether this will assist with the water infiltration problem in the lower level.

Ecological Observatory

Power to the observatory is provided by a link to the nearby residence. The house was sold and the new owners, Joe Costa and his wife, Cathy, agreed to provide us with electricity for the array. An agreement was struck which is in effect until October of 2005.

Shortly after installation (November 13, 2003), a nearby lightning strike fried receivers, computer and hydrophones in the Warner Lake system. After these repairs and replacements were made during winter, a second lightning strike in spring (April) of 2004 necessitated a complete overhaul of the system of protection for the array.

Accordingly, one of the foremost experts on lightning, Merlin Demaray (Power Quality Engineering Consultant) from RO Associates was engaged to do a consultation on site and prepare a plan for effective lightning protection. As a result of this visit, a series of steps were taken to protect the system from further damage. At the point of entry of power lines into the cabin, an isolation transformer and an over-voltage protector (silicon avalanche suppressor diodes) were installed. In addition, all electronic components operate through a protected UPS system (with IGBT inputs and outputs). A ground plate was installed to which the panel and all electronic equipment was individually grounded. New hydrophones were installed with voltage clamps at both ends of the cabling to prevent induced voltage spikes. Thanks to Dr. Cory Suski for his work as SCUBA diver/repairman. The new system is protected at both ends - connection to hydro supply from the outside and connection to water and atmosphere at the detectors. New receivers and a new computer completed the overhaul.

The observatory has been working well since the reconfiguration. Data are being used for Kyle Hanson's Master's thesis (see Dr. Philipp's research section) and for Caleb Hasler's undergraduate thesis. In conjunction with mapping data provided by Dr. Roly Tinline's crew from Queen's Geographical Information Systems Lab, Dr. George Niezgoda is preparing a paper on the quality of information collected by the array.

The two-year startup period generously funded by the Office of Research Services at Queen's (\$10,000 negotiated on behalf of the project by Dr. R. Tinline) is coming to an end (October 2005). Before that time, the

consortium of users will have to have a new management and operational framework in place to ensure the continuance of the project.

Brown Lab

In the upper level, a partition wall was installed to separate the office space in the NE corner and the collections room. With a new door and electrical switches, the collections room is now self-contained. Access is possible from the classroom/conference room or the office. This change better defines both the office space and the space for collections.

Sumac Cottage

In the kitchen area, the old vinyl flooring had heaved and cracked, so it was removed and new vinyl tiles were installed. At the same time, the old, faulty stove was removed. This seldom-used appliance is not missed and its removal has opened up more available floor space in the cottage.

Mattresses

Careful appraisal was made of all of the mattresses on site. All mattresses were scored from A - good through D - bad. The bad mattresses (9 in total) were replaced in spring with new ones purchased at Elgin Home Furnishings (Elgin). Plans are to replace mattresses using the scoring scheme, a few of the worst ones each year.

Cabin 15

The old flooring was removed and new sheet vinyl flooring installed in the main room. In the bedroom, a new carpet runner was laid down alongside the bed.

Cabin 6

Cabin 6 is one of our old "bunkie juniors". The roof had been leaking for some time. Thus, the roof was stripped, the rotting wood at the eaves replaced and new shingles installed. A few bits of new fascia and some paint completed the work.

Septic Systems

To complete the replacement of the main system, new access hatches were built and installed atop the septic tanks in front of the lodge and atop the pump chamber near the workshop. These hatches make access during maintenance easy and clean.

A similar hatch was installed atop the septic tank at Maplewood Cottage.

At Keast Cottage, reports of improper functioning led to the sewage pump chamber being excavated and a new pump switch installed.

Basswood Cabin

A new entry deck and steps were installed in summer to replace the deteriorating steps and deck on the north side of this duplex cabin.

Power Supply to Leach Field

To obviate extension cords laid across the leach field, an underground wire was laid from Maplewood Cottage to an outdoor outlet mounted on a post at the south side of the leach field. The moth/bat researchers used this to power their collecting lights - no more extension cords.

Boardwalk

Repairs were made to posts and walkway planking on the far side of the boardwalk near Cow Island. It seems that some repair is needed every year now that the boardwalk is 20 years old.

High-Speed Internet

In conjunction with Kevin Christy (Rural Broadband Services - Elgin), steps were taken to lay the groundwork for this connection to the outside world. Conduit was laid from the Operations Centre to the White House, from the White House to the Manager's House, then from the Manager's House to the tower atop the hill between the Manager's House and the Assistant Manager's House. Cables were pulled through the conduit and up the tower. Kevin added two sections of tower to Jay's old CB tower to get direct access across the hills to the link tower at Chaffey's Lock. Late in 2004, the system was up and running. Our Local Area Network is now linked to broadband wireless.

Manager's House

In late fall, an interlocking brick walkway was laid down from the driveway up to the Manager's House. This walkway replaces the temporary (25 years!) walkway of sidewalk slabs laid during construction of the house.

CFI Storage Building

In fall, crushed gravel was added to the roadway to the building and the access pad directly in front of the building. The gravel was carefully graded and packed. Some landscape blocks were added around the entry door at the south end of the building, the form was filled and topped with sidewalk slabs to complete the entryway.

Researchers began to use the storage loft for extraneous lab gear, freeing up space in labs for other groups and uses.

Dump Trailer

Our workhorse trailer needed an overhaul. It was rusting, the floor was rough and the mechanisms, surge brakes and hydraulic dump were failing. As a consequence, a thorough refit was done. Using checkerplate supplied by Doug Trudel, a new floor was installed. It should now be able to hold anything at all. A new hitch with surge brake actuator was installed. The dump mechanism was cleaned and refitted and reinstalled in a plastic case to keep rain and dirt off the works. The trailer was completely sandblasted, primed and painted. It was then as good as new - maybe better.

Workshop

A new propane space heater was purchased and installed by Superior Propane in the rear corner of the shop. This hanging heater with forced exhaust replaces our old, balky heater. Incidentally, the old one was the original from the heydays of the Trilab (1950s?) which was taken out and subsequently retrieved from storage and put into service in the workshop some 20 years ago.

A MIG welder was purchased for the workshop for fine work. It was immediately put into use in building the handrails on the deck of the lodge and in refitting the dump trailer.

Roads

In fall, crushed stone was added to the road to Curran Cottage, to the parking areas near the workshop and to the hill on the main road just beyond the Earl Cottage driveway.

Landscaping

Marg worked to tame the rampant weeds atop the berm in front of the White House.

In fall, stone dust was added to the walkway from the White House to the lower level entrance to the lodge.

The Weather Report 2004

The QUBS weather station configuration and operation and the characteristics of the data it collected in 2004 remained essentially unchanged from 2003. The reader is referred to our “Annual Report and Newsletter – 2003” for a summary, and to Assistant Manager Floyd Connor for additional details.

Two charts summarizing rainfall and selected temperatures on a weekly basis from 01 April through 29 December 2004 are included here. Comparable charts for April through October of years 2000 through 2003 are included in the Annual Report for 2003.

The current brief summary points out a few highlights of 2004 weather.

Rainfall exhibited notable extremes. There was a heavy rain in late May and another in early June. The latter may have been incorrectly recorded, for on the afternoon of 09 June a number of otherwise reliable sensors recorded erroneous values that may have been caused by a lightning storm. Field notes taken by 3 different research teams suggest there may have been a storm then, and the tipping bucket rain gauge recorded just over 19mm of rain in one 10-minute interval. If correct (?), this would certainly be a notable “cloudburst”. For the two variables in this summary which were affected, “SoilT Avg DegC” and “WaterT 3.3m DegC”, the component for 09 June was eliminated and the values were calculated from the preceding 6 daily values. There was another very wet week at the end of July and beginning of August, then a notably dry period extending through 08 September. On 09 September, heavy rain for much of the day (fallout from one of Florida’s four devastating hurricanes of 2004) added up to 124 mm. The next 4 weeks were almost completely dry, but rains occurred again from mid-October through December. December accumulated a remarkable total of 175.5 mm of water equivalent of precipitation, with 96.5 mm being recorded on 23 December. Even taking into account the fact that some of this may have been melting snow and ice, this remains an extreme amount.

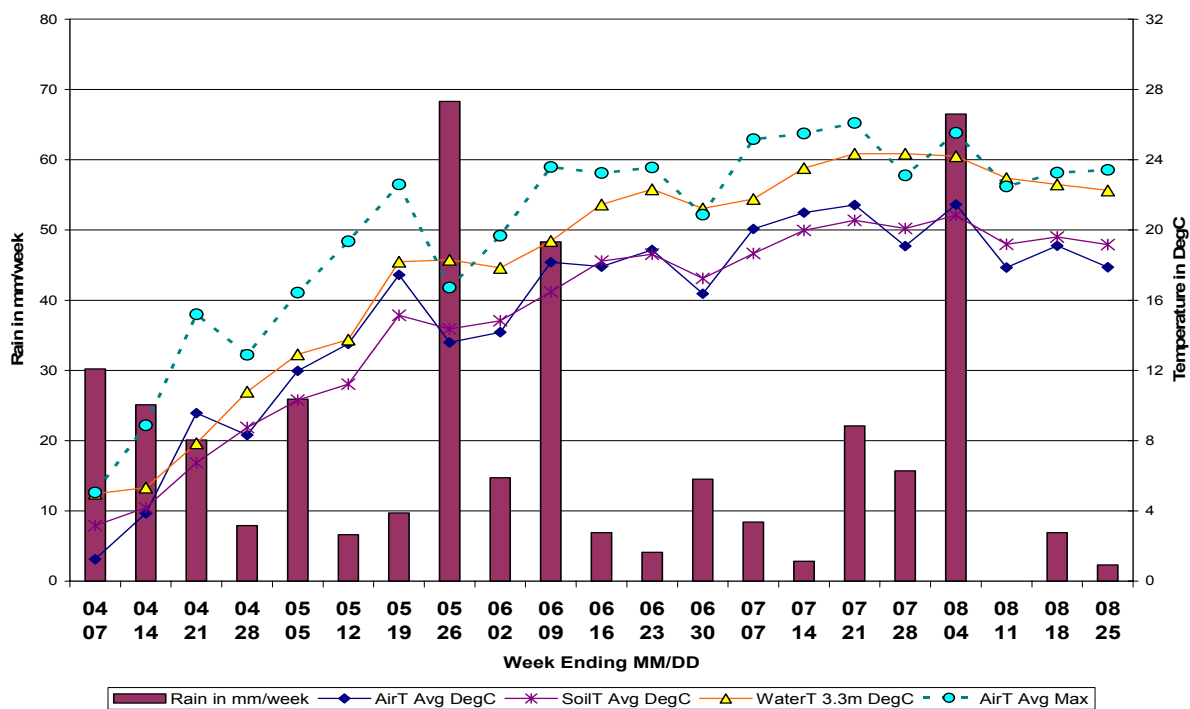
Temperatures were moderate for most of the season summarized. The weekly averages of daily air temperature maxima (“AirT Avg Max” on the charts) only once crept as high as 26.09 degrees C (in the week ending 21 July), and the highest single-day air temperature maximum noted was 28.5 degrees C on 12 July 2004.

“Ice Off” (ice gone from a lake, except for possible small traces in some bays) and “Ice On” (ice forming a complete cover on the specified lake) dates are listed, where known, for 3 lakes for 2003 and 2004 in the following table. It is thought that these values may have some relevance for some of the studies on fish behaviour and ecology. NA = “Not Available”

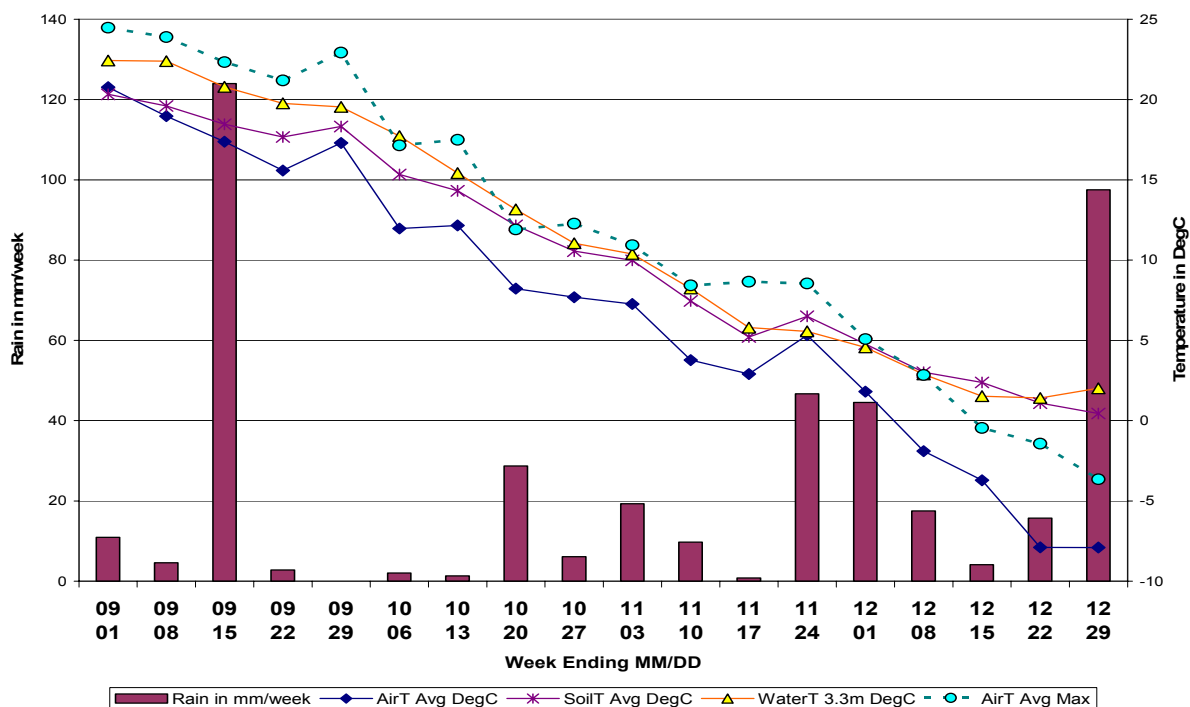
Ice Dates for 3 Opinicon-Area Lakes, 2003 and 2004

		2003	2004
Lake Opinicon	Ice Off	19 Apr	13 Apr
	Ice On	08 Dec	15 Dec
Warner Lake	Ice Off	NA	06 or 07 Apr
	Ice On	02 Dec	05 Dec
Upper Rock Lake	Ice Off	15 Apr	12 Apr
	Ice On	16 Dec	22 Dec

Weekly Rain and Temperature - Apr 01 thru Aug 25 2004



Weekly Rain and Temperature - Aug 26 thru Dec 29 2004



Transit of Venus by Beth Clare

A transit of Venus is one of the rarest planetary alignments we can observe. It has occurred only 6 times since the invention of the telescope.

A transit of Venus occurs when Venus passes between the earth and the sun and appears as a small black disc on the face of the sun. Transits of Venus come in pairs and occur only in the months of June and December. The next transit will be in June of the year 2012. After that Venus will not transit the sun again before the pair in December 2117 and December 2125.

In 1882 while observing the last transit of Venus, Astronomer William Harkness made this comment...

"We are now on the eve of the second transit of a pair, after which there will be no other till the twenty-first century of our era has dawned upon the earth, and the June flowers are blooming in 2004. When the last transit season occurred the intellectual world was awakening from the slumber of ages, and that wondrous scientific activity which has led to our present advanced knowledge was just beginning. What will be the state of science when the next transit season arrives, God only knows. Not even our children's children will live to take part in the astronomy of that day. As for ourselves, we have to do with the present ..."

This year at the Queens University Biological Station 11 of us got up at sunrise on June the 8th to witness this rare event. The sun rose ember-red into a smoky sky, and the transit was briefly visible even to birders with just their binoculars. A rare treat indeed!



*Photographs by Beth Clare, edited by Bruce Smith
QUBS, 08 June 2004*

Table 1: Summary of enrolments in the Ontario Universities Program in Field Biology in 2003 (QUBS courses highlighted)

Course	Instructor	Affiliation	Module	Location	B	C	G	M	O	Q	To	Tr	Wa	We	Wi	Y	Other	TOTAL
1	Burke and Nol	Trent	Wintering Neotropical Migrants	Cuba	0	0	0	0	0	0	0	15	0	0	0	0		15
2	Hebert and Ballantyne	Guelph	Tropical Ecology	Australia	0	1	15	0	1	1	0	1	0	1	0	0		20
4	Duthie	Waterloo	Rainforest and Reef	Costa Rica	0	1	3	1	1	2	0	2	4	1	0	0		15
6*	Bazeley	Toronto	Carolinian Forest Ecosystems	Pinery Prov Pk	1	1	1	0	2	2	0	0	1	2	0	2		12
7	Lougheed/Blouin-Demers	Q/Ottawa	Ecology of Amphib/Reptiles	QUBS	0	0	1	0	3	3	0	1	1	2	0	1		12
8	Eckert	Queen's	Spring Flowering Plants	QUBS	1	1	2	0	2	4	0	1	0	1	0	0		12
9	Picman	Ottawa	Avian Reproductive Tactics	QUBS	0	1	2	0	2	1	0	1	1	2	1	1		12
10	Robertson	Queen's	Behl Ecol/Conserv Biol of Birds	QUBS	0	2	0	1	0	4	0	0	1	1	0	1		10
11	Rising	Toronto	Field Ornithology	HMSC	0	0	2	2	0	1	16	1	1	1	0	0		24
13	Darling and Agarawal	Toronto	Biodiv/Ecology in Indochina	Vietnam	0	1	1	0	2	2	5	0	1	1	2	0		15
14	Drouillard	Windsor	Great Lakes Field Biology	GLIER	0	1	2	0	2	2	1	0	0	2	1	1		12
16	Gaston	Ottawa	Community Ecology	Queen Char Isl	0	1	0	0	2	0	0	0	1	1	1	0		6
17	Sale and Kritzer	Windsor	Coral Reef Fishes	Belize	0	0	2	2	2	2	1	1	0	2	0	0		14
18	Sager and Smith	Trent	Ecology of the Kawarthas	Oliver Centre	1	1	0	1	1	2	2	2	0	1	0	1		12
19	Conlan	Carleton	Marine Invertebrates	HMSC	0	3	2	1	2	2	4	2	1	3	1	1	3	25
21*	Hunter and Richardson	Brock	Aquatic Insect Ecology	Algonquin Park	1	1	0	0	2	1	2	1	1	2	0	1		12
22	Runtz	Carleton	St. Lawrence Forest Ecoregion	Dorset	0	4	0	0	0	1	2	1	1	2	1	0		12
23	Handford,Bowles,Lougheed	Western/Q	Biodiversity of NW Argentina	Argentina	0	1	0	0	2	2	1	1	1	2	0	0		10
24	Schreer	Waterloo	Marine Mammals and Seabirds	HMSC	0	0	3	0	2	3	4	1	3	4	2	0	3	25
25	Hebert and Kevan	Guelph	Arctic Ecology	Churchill	0	1	16	0	0	0	0	0	0	1	0	0		18
26	Fenton	Western	Behavioural Ecology of Bats	QUBS	1	2	0	0	3	3	2	0	1	2	1	1		16
27	Findlay	Ottawa	Field Ecology	QUBS	0	1	0	1	6	1	1	1	1	0	0	0		12
28	Brooks	Guelph	Field Ecology	Algonquin Park	0	0	17	1	0	2	1	1	0	2	1	0		25
29*	Pringle	McMaster	Systematics Flowering Plants	QUBS	1	2	1	0	1	1	2	0	1	2	1	0		12
30	Miller and Bailey	Western	Alpine Ecology	Kananaskis	0	2	0	0	1	3	1	1	1	5	1	1		16
31	Cumming	Queen's	Aquatic Ecology	QUBS	0	1	0	1	1	4	1	1	1	1	1	0		12
32*	Gunderman	McMaster	Insect Taxonomy and Ecology	QUBS	1	1	0	0	1	2	1	0	1	1	1	1		10
33*	Yan	York	Aquatic Restoration Ecology	Sudbury	1	0	0	1	0	1	1	1	1	1	1	2		10
34*	Zimmerman	Toronto	Conservation Lake Ecosystems	Harkness	0	1	0	1	0	2	6	1	1	1	1	2		16
35/36	Staples	Western	Marine Biology	HMSC	0	1	0	0	1	2	4	1	2	6	3	0		20
37*	Havelka	Toronto	Small Mammals	Koffler	1	0	0	0	1	0	5	0	1	1	0	1		10
38	Barton	Waterloo	Terrestrial/Aquatic Ecosystems	Algonquin Park	0	1	0	2	0	2	2	1	4	1	2	1		16
39*	Williams	Toronto	Tropical Marine Biology	Barbados	0	1	4	0	0	0	10	0	0	0	0	0		15

* one week module

# of students	9	34	74	15	43	58	76	39	34	53	24	18	6	483
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# student-weeks	12	61	142	28	79	104	123	75	61	96	44	27	12	864
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B=Brock C=Carleton G=Guelph 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 2004

	Brock	Carleton	Guelph	McMaster	Ottawa	Queen's	Toronto	Trent	Waterloo	Western	Windsor	York	Other	Total Student-Weeks	Total Half-Course Credits
Total Student-Weeks Not at QUBS	6	42	131	22	43	62	114	65	47	75	36	18	12	673	336.5
Total Student-Weeks at QUBS	6	19	11	6	36	42	9	10	14	21	8	9	0	191	95.5
Total Student-Weeks in Field Modules	12	61	142	28	79	104	123	75	61	96	44	27	12	864	
Total Half-Course Equivalents in Field Modules	6	30.5	71	14	39.5	52	61.5	37.5	30.5	48	22	13.5	6		432

22.1% of credits in entire program earned at QUBS in 2004 (11.9% in 2003; 13.5% in 2002; 14% in 2001; 24% in 2000)

40.4% of Queen's credits earned at QUBS in 2004 (21.3% in 2003; 41% in 2002; 30% in 2001; 47 % in 2000)

Research Conducted by Queen's University Personnel in 2004

Dr. Lonnie W. Aarssen - Department of Biology

“Plant Ecology and Evolution”

Brandon Schamp - "Density-dependent mortality of perennial plant species grown in mixture vs. monoculture" - Ph.D. 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. This number was determined using germination experiments done in a growth chamber in the lab.

The number of individuals germinating in each of the monocultures was monitored for a period of 8 weeks after planting to determine the number of individuals that could be expected to germinate in a plot for a given species. This number will be used to assess mortality rates for individual species in monocultures, and to estimate mortality rates of individuals in mixtures. These mortality rates will be compared in light of species-specific traits to determine whether traits are predictive of competitive success.

Assistants: Ryan Oukama, Andrew Stevens, Joyce Chau, Michael Burtnyk, Jennifer Waugh

Acknowledgements: Funded by NSERC discovery grant to LWA
Funded by NSERC PGS-B grant to Brandon Schamp

Andrew Stevens - "The effects of seed size and granivory on plant community structure in an old field" - B.Sc. Thesis

Plants have a variety of different strategies to maximize dispersal and germination. Seed size has been shown to relate to both of these factors and also may incur differential predation depending on the ecosystem and the abundance of seed predators. This study was undertaken to test whether seeds in different size categories (large, medium or small) were subject to different levels of seed predation in an old field ecosystem, and if this has an effect on the structure of plants in the community.

Cages were designed to exclude avian and large mammalian predators and protect the treatments from rain or direct sun exposure. Small mammals (mice, voles, etc.) and insects had access to seeds placed in petri dishes on the ground in these cages. Three different treatments were set per cage, one as a control with the petri dish lid on, one exposed to all predators, and one inside a second smaller metal cage to exclude mammals and allow only insects access to the seeds. Each treatment was set with 30 seeds sprinkled on the surface of half a centimetre of sterilized soil.

The cages were set randomly in a study plot of the Lane Sargeant Field at Queen’s University Biology Station. The experiment was run for three consecutive two week periods in July and August exposing six species of seeds at a time with five replicates of each species. A second six week trial was also run in November and December with the same 18 species to test for seasonal effects of seed predation. Percent recovery of seeds from each treatment will be compared across species and seasons to determine if there is an effect of size in differential seed predation. Results will also be compared to species composition and abundance in the Lane Sargeant Field to determine if seed predation has an effect on community structure.

Assistants: Ryan Oukama, Brandon Schamp, Joyce Chau, Michael Burtnyk, Jennifer Waugh

Acknowledgements: Funded by NSERC discovery grant to LWA

Theses:

Chau, J. 2004 Interspecific competition and co-occurrence of vascular plants at neighbourhood scales in an old field: a multi-pair-wise study using null models. BSc Honours Thesis, Queen's University.

Cunningham, J. 2004 Mean-variance relationships for species size in vegetation: indicators of competition driven community assembly? BSc Honours Thesis, Queen's University.

Dr. Shelley Arnott - Department of Biology

"Aquatic Ecology"

QUBS was used as a sampling location this past year. Alison Derry collected some sediment samples for zooplankton resting eggs in September. These will be used to develop methods for hatching zooplankton resting eggs that were historically deposited in lake sediments. We are interested in determining if there have been ecological and genetic changes in the zooplankton, particular the species *Leptodiatomus minutus*.

Dr. Tim Birt and Dr. Vicki Friesen - Department of Biology

"Studies in Hybridization"

Katherine Lafranier - "Studies in Hybridization between bluegill and pumpkinseed sunfish, *Lepomis macrochirus* and *L. gibbosus*" - B.Sc. Thesis

Bluegill and pumpkinseed sunfish hybridize frequently and produce viable offspring in Lake Opinicon. In an attempt to gain better understanding of the phenomenon we are using DNA sequencing to characterize variation at several intron loci in the two species. This will permit an analysis of the extent of genetic introgression in these sunfishes. This information will also be useful in developing a better understanding of the apparently nonrandom nature of hybrid viability. The work is being done by Katherine Lafranier in collaboration with Dr. D. Philipp.

Publications:

Veit, M. L., R. J. Robertson, P. B. Hamel & V. L. Friesen. 2004. Population genetic structure and dispersal across a fragmented landscape in cerulean warblers (*Dendroica cerulea*). Cons. Gen., accepted Aug. 2004.

Dr. Chris Eckert - Department of Biology

"Reproductive Ecology of Plants"

Emily Darling – “On the importance of being separated: herkogamy and variation in natural populations of flowering plants” – B.Sc. Thesis

Since the publication of Darwin’s classic book, *The Different Forms of Flowers on Plants of the Same Species* (1877), biologists have been fascinated with the complexities of plant reproductive biology. One of the most important mating system traits in hermaphroditic plants is herkogamy, the spatial separation of pollen presentation in male anthers and pollen receipt in female stigmas. The degree of herkogamy within individual flowers can affect mating strategies as increased spatial separation promotes outcrossing while decreased separation increases self-fertilization. Therefore, variation in herkogamy within flowers and between individuals and populations can have drastic effects on fitness, suggesting that herkogamic variation should be minimized by stabilizing selection. We predict that in natural populations of flowering plants, herkogamy should show less variation than other reproductive traits within the same flower.

This hypothesis of reduced relative variation in herkogamy was investigated in ten different plant species (see list below) found throughout the QUBS vicinity. Primarily, sampling was conducted throughout Cow Island marsh and along Opinicon Road and the Cataragui trail systems. For several population of each species, the floral architecture of thirty individuals were digitally photographed such that herkogamy and other floral traits (flower length, corolla width, anther and stigma length, etc.) could be measured with image analysis software. Data are currently being analysed and QUBS will be kept up to date with any relevant findings.

Plant List:

Common Name	Scientific Name
Fly Honeysuckle	<i>Lonicera canadensis</i>
Bladder campion	<i>Silene cucubalus</i>
Bittersweet nightshade	<i>Solanum dulcamara</i>
Common mullein	<i>Verbascum thapsis</i>
Viper’s bugloss	<i>Echium vulagre</i>
Horned bladderwort	<i>Utricularia cornuta</i>
Purple Loosestrife	<i>Lythrum salicaria</i>

Dr. Paul Grogan - Department of Biology

"Nitrogen Cycling in Southern Ontario Forested Ecosystems"

Nitrogen is commonly accepted to be the limiting nutrient for terrestrial, temperate ecosystems. The overuse of fertilizer and the burning of fossil fuels have led to an increase in the volume of nitrogen entering the cycle. Too much nitrogen can have deleterious effects in some ecosystems. Forest ecosystems represent important nitrogen sinks because nitrogen can be sequestered for hundreds to thousands of years. However the detailed mechanisms of how these systems function are not well understood. Some evidence exists that there is a species effect produced by sugar maple (*Acer saccharum*) that increases the levels of nitrate in soils. Nitrate is the most mobile form of nitrogen and can move easily from terrestrial to aquatic systems.

Erik Coleman - “Nitrogen cycling in Southern Ontario Forested Ecosystems” -B.Sc. Thesis

We are trying to confirm the species effect of sugar maples by measuring different forms of nitrogen in single species plots of sugar maple, red oak, American beech and white pine trees in a mature forest setting. We use a push corer to collect soil samples in the late summer and autumn. In addition to the above, we are exploring some

of the potential mechanisms by which the species effect could occur. We will investigate potential species effects on soil microbial biomass content of nitrogen and carbon. In addition, as our QUBS sites (opposite Skycroft campground) are all considered to be Canadian Shield-based sites, we have a second set of sites on a limestone substrate (not QUBS property) to investigate the potential impacts of substrate pH.

Assistant: Brian Reid (SWEP student)

Dr. J. Allen Keast - Department of Biology

"Fish Species Habitat: Definition, Biological Needs and Conservation"

Few subjects have received the attention of habitat. Every fish book acknowledges that "habitat" is a "species character", whilst providing a fairly accurate, if superficial, designation. When it comes down to defining species presence/absence however, habitat designation is anecdotal and unsatisfactory. Accurate designation is elusive and energy-demanding.

Analysis of the fish species components of communities in small lakes and streams is being explored using our comprehensive databases of species diet, habitat usage, seasonal and ontogenetic (age ecology) influences, built up over twenty years in Lake Opinicon and other lakes. In many cases distributions are readily explained by body form, feeding behaviour and selectivity and spawning requirements. In other cases, even with full data sets, distributions remain unexplained.

The overall objective is to define and explain habitat use for a spectrum of common and important fish species, with a view to understanding basic biology and conservation. A secondary objective is understanding the variation in fish community composition with habitat and lake type. Compositional differences have implications for resource division and energy flow patterns.

Dr. Kurt Kyser - Department of Geological Sciences and Geological Engineering

Andrew Bukata - "Metal and isotopic variations in tree rings as a proxy for environmental change in Southern Ontario" - Ph.D. Thesis

Increased settlement and industrialization of southern Ontario since 1850 has caused significant changes to the natural environment. Land-use has changed from forest to farming, to increased urbanization and industrial use. Absent direct instrumental measurements, proxy records must be found to assess the impact that this anthropogenic stress has on the environment. My thesis examines whether the chemical and isotopic composition ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) of tree rings make faithful recorders of environmental change in the presence of multiple point sources of pollution in southern Ontario.

In order to cover a wide geographic range, I selected five sites across southern and into northern Ontario within the natural range of Red and White Oak. These sites also cover a wide range of soil and bedrock types. Three sites (Burlington, Peterborough, and Kingston) are entirely underlain by carbonate bedrock, one (North Bay) is entirely underlain by granitic bedrock and one site (Lake Opinicon, QUBS) lies at the contact between the granitic Canadian Shield and the carbonate bedrock of southern Ontario. The QUBS site is particularly significant as it allows for trees to be sampled from a very narrow geographic range which cover a wide range of geochemically distinct terrains. This allows for the examination of, and correction for, the effect of lithology on tree ring chemistry. QUBS serves as an important southern reference site for comparison to North Bay, and a northern reference site for Burlington, Peterborough and Kingston.

Dr. Kurt Kyser, Dept of Geological Sciences and Geological Engineering and **Dr. Len J.S. Tsuji**, Dept of Environment and Resource Studies, University of Waterloo

“Effects of soil acidification and bismuth shotshell pellets on southern Ontario ecosystems”

Bismuth shotshell has been used as a non-toxic alternative to lead but the environmental fate of bismuth has not been studied adequately. Moreover, it is well known that metals are mobilized under acidic conditions (*i.e.*, they become bio-available) and acidic deposition continues to impact on southern Ontario where reductions in sulphur emission have been offset by nitrogen emissions. 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 a sugar maple forest (Hughson tract, adjacent to the Stokes field) and a sedge marsh (Osprey Marsh) at QUBS in 1999 and assigned plots to one of four treatments: (1) soil acidification (annual applications of ammonium sulphate fertilizer), (2) bismuth pellets (applied once in 1999), (3) acidification + bismuth pellets, or (4) no treatment controls. In addition to bismuth, we also measured lead and tin since these metals are minor constituents of bismuth pellets. 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 in general.

Lisamarie Akesson – “Dendrochemistry reveals that experimental soil acidification mobilizes bismuth from bismuth shotshell pellets in hardwood forests of southeastern Ontario, Canada” – B.Sc. Thesis with Dr. Kyser

We employed dendrochemistry as a spatial and temporal integrator of environmental conditions before and after the application of bismuth pellets and soil acidification. We analyzed tree-ring chemistry for 1999-2003 (treatment years) and compared it to 1970-1974 in two mature trees per treatment. Soil pH in acidified plots decreased by 0.9 compared to an increase of 0.5 measured for soil from non-acidified plots; however, there was little change in soil bismuth across treatments. Dendrochemistry, however, revealed a different pattern for bismuth compared to the soil analyses. Sugar maples receiving bismuth pellets and acidification, in isolation or in combination, had elevated bismuth in sapwood compared to control trees, as did bitternut hickory that received bismuth pellets and acidification. Our pilot study indicates that soil acidification mobilizes bismuth from pellets into the forest biogeochemical cycle within a 4-year period. We will continue with the acidification treatments such that future work will compare all trees in the study ($n=6$ per treatment) and then acidification treatments will be discontinued to monitor ecosystem recovery.

Nathan Fahey – “Effects and fate of bismuth shotshell and simulated acid rain on southern Ontario wetlands” – MES Student with Dr. Tsuji

Alkaline elements in the test plots prevented the soil pH from being artificially lowered, so that the effects of acid rain on bismuth shotshell pellets in buffered soils were realized, but not in unbuffered soils. It was determined that once the bismuth was introduced into the soil it remained at significantly high concentrations for the entire 4-year period. The second objective of this study was to monitor the uptake of bismuth in vegetation. While there was no increase of bismuth in the plant tissues, this does not exclude the possibility that the metal was accumulating in the root and rhizome systems (that have not been analyzed in this study). As an alternative, we will undertake a statistical comparison to determine if excess bismuth in soil could be correlated with vegetation growth. This study has demonstrated that bismuth is immobile under neutral soil pH conditions in wetlands and its impact upon vegetation is inconclusive.

Jim Karagatzides (Department of Geography - Queen's), Dr. Leonard Tsuji and Dr. Kurt Kyser – “Potential shifts in wetland plant nutrient limitation in response to chronic acidic deposition”.

Atmospheric deposition of nitrogen (“acid rain”) continues to impact severely many ecosystems on earth. Whilst some additional inputs of nitrogen can initially stimulate ecosystem production, excess nitrogen loading can lead to nutrient imbalances when other essential elements (e.g., phosphorus, potassium) are not provided at required levels. Plant growth in most wetlands is limited by nitrogen but recent research has revealed that productivity in many wetlands is co-limited by phosphorus and/or potassium. We take advantage of the acidification treatments in the bismuth plots (described above) to test the hypothesis that increased nitrogen deposition from acid rain will shift wetland vegetation from nitrogen to phosphorus or potassium limitation. We sampled shoots and leaves of *Carex lacustris*, the dominant species in our plots at Osprey Marsh, from the acidified and non-acidified plots to measure nitrogen- phosphorus-potassium content in response to four years of simulated excess nitrogen deposition. Results are forthcoming and will be compared to critical ratios of these nutrients for optimum growth of wetland plants.

Dr. Stephen Loughheed - Department of Biology

“Origins and Diversification of Temperate and Tropical Vertebrates”

Our lab is interested in the forces that generate and shape vertebrate diversity (primarily frogs, reptiles, and birds). We integrate studies of patterns in high-resolution DNA markers, morphology and advertisement calls with experimental approaches to understand the significance of this variation. Our research projects contribute to basic issues of understanding biodiversity origins in both North and South America, and to providing direct inputs into the management strategies for taxa of conservation concern.

James Austin - “Multi-scale perspectives on the genetic structure of a widespread amphibian, the North American Bullfrog, *Rana catesbeiana*.” – Ph.D. Thesis

My research interests span various aspects of molecular ecology, phylogenetics, and conservation. My Ph.D. dissertation explored the relationship between scale (both temporal and geographic) and neutral genetic structure, and an examination of what the relationship tells us about the formation and structuring of genetic diversity. My dissertation consisted of four projects that focused on different scales, using *Rana catesbeiana* as the focal species: 1) A phylogenetic and biogeographic analysis of the *Rana catesbeiana* species group. 2) A comparative phylogeographic study of two ecologically and phylogenetically divergent species (*R. catesbeiana* and the spring peeper, *P. crucifer*). 3) A study on the effect of history and scale on accurately estimating levels of gene flow. 4) Testing a hypothesis (based largely on known ecological information) of female-biased dispersal in *R. catesbeiana*. My more recent research based at Cornell University expands on these themes, and involves temperate amphibian species that I use to investigate historical and contemporary patterns of gene flow, hybridization, and the relationship between putatively neutral genes and patterns of adaptive divergence.

Assistants: James McKee, Daniel Liadsky, Mary Vallianatos

Briar Howes - “Ecological and genetic analysis of the five-lined skink.” – Ph.D. Thesis

My interests relate to the genetics and ecology of wild populations particularly as these pertain to questions of evolutionary biology and conservation. My doctoral thesis project focuses on the five-lined-skink, Ontario's only lizard species and in fact the only Canadian lizard species east of Manitoba. The five-lined skink is designated as "Special Concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and Vulnerable by the Ontario Ministry of Natural Resources (OMNR). Reasons for a decline of this species in Canada include

large-scale habitat loss, loss of specific microhabitat, and illegal collecting. I am using a combination of mtDNA sequence data and high-resolution DNA microsatellites to investigate patterns of genetic diversity among populations of five-lined skinks across their eastern North American range. My ultimate goals are: i. to examine whether two disjunct series of populations in Ontario are genetically distinct, ii. to embed Canadian skink populations within the genetic landscape of the entire species, and iii. to test whether within-population genetic diversity in peripheral populations is reduced compared to core populations. To date, I have collected 800 tail tip samples from southern Ontario and 26 states across the eastern U.S. To examine the history of the species and to map out distinct units within the range, I have sequenced ~170 individuals for an 800 bp region of cytochrome *b* in the mitochondrial DNA. To determine if geographically peripheral populations have reduced intrapopulation genetic diversity and gene flow, I have designed and optimized 6 microsatellite loci and genotyped 750 individuals for 6 loci.

Assistants: Bethany Lindsay, Sheri-Lee Harper, Sarah Sharp, Julie Lee-Yaw, Daniel Liadsky, Mike Rae, Ryan Bolton

Publications:

- Austin, J.D., S.C. Loughheed & P.T. Boag. 2004. Controlling for the effects of history and non-equilibrium conditions in gene flow estimates in northern bullfrog (*Rana catesbeiana*) populations. *Genetics* 168: 1491-1506.
- Austin, J.D., S.C. Loughheed & P.T. Boag. 2004. Discordant temporal and geographic patterns in maternal lineages of eastern North American frogs, *Rana catesbeiana* (Ranidae) and *Pseudacris crucifer* (Hylidae). *Mol. Phylogenet. Evol.* 32: 799-816.
- Howes, B.J. & S.C. Loughheed. 2004. The importance of cover rock in northern populations of the five-lined skink (*Eumeces fasciatus*). *Herpetologica* 60: 287-294.
- Howes, B.J., J.A. Lee-Yaw, A.V. Robertson, J.P. Bogart & S.C. Loughheed. 2004. Microsatellite loci from the five-lined skink (*Eumeces fasciatus*). *Molec. Ecol. Notes* 4: 237-238.

Dr. Robert Montgomerie - Department of Biology

"Sperm Competition"

In 2004 I continued my research on sperm competition and the evolution of sperm morphology, using QUBS largely as a field site for frogs and fishes that were brought back to the lab at Queen's for fertilization experiments, and measurements of sperm morphology and behaviour. With Dr. Cory Suski (currently NSERC postdoc at Trent), I conducted some fertilization experiments in bluegill (*Lepomis macrochirus*), continuing research on the mechanisms of sperm competition in this species, that I started in 1995. Our recent discoveries with respect to sperm energetics and behaviour in this species (Casselman and Montgomerie 2004; Burness et al. 2004, 2005) have some wider implications for the evolution of sperm and fertilizing mechanisms in all organisms.

With Drs. Jim Austin (NSERC postdoc at Cornell) and Steve Loughheed (Asst Prof at Queen's), I 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.

Publications

- Burness, G., Schulte-Hostedde, A., Casselman, S., Moyes, C., Montgomerie, R. 2004. Sperm morphology, motility and energy stores differ between reproductive tactics in male bluegill (*Lepomis macrochirus*). *Behavioral Ecology & Sociobiology* 56:65-70.
- 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.

- Casselman, S., Montgomerie, R. 2004. Sperm traits in relation to male age and phenotype in colonial spawning bluegill, *Lepomis macrochirus*. *Journal of Fish Biology* 64:1700-1711.
- Doucet, S., Mennill, D.J., Montgomerie, R., Boag, P.T., Ratcliffe, L.M. 2005. Achromatic plumage reflectance predicts reproductive success in male black-capped chickadees. *Behavioral Ecology* 16:218-222.
- Norris, R., Kyser, K., Montgomerie, R., Marra, P., Ratcliffe, L.M. 2004. Molt migration and plumage color in response to the cost of reproduction. *Science* 306:2249-2250.

Dr. Chris Moyes -Department of Biology

"Evolution and Development of Centrarchid Muscle Energy Metabolism"

Animals use their muscle to power locomotion. Because the locomotory muscle of fish is such a large proportion of their body mass, the metabolic properties of the muscle dominate whole body energetics. We are studying the evolutionary and environmental factors that govern the design of energy metabolic pathways in centrarchid fish. The Opinicon area has large populations of multiple species of centrarchids with important differences that make them important models for metabolic studies. First, they differ widely in activity patterns, from sedentary sunfish to athletic smallmouth bass. Second, they differ widely in hypoxia tolerance, an environmental factor that is known to alter the design of metabolic pathways. Third, the group as a whole demonstrate profound differences in body size, which influences muscle energetics across taxa (i.e. allometric scaling). The studies begun this year were limited to enzymatic analyses, with subsequent studies planned to examine the links between metabolic patterns of the animal, the properties of the muscle, and the links between gene expression and metabolic traits of the fish.

Dr. Laurene Ratcliffe - Department of Biology and **Dr. Peter Marra** - Smithsonian Environmental Research Center, Edgewater, MD

"Seasonal Interactions and Population Ecology of a Long-distance Migratory Songbird, the American Redstart (*Setophaga ruticilla*)"

Now in its fourth year, our overall goal is to understand the factors that influence individual fitness and population abundance in a long-distance migratory bird. We use a combination of field observations, experiments and stable isotope analysis to examine the influence of tropical winter habitat quality on the timing of arrival, reproduction, and survival on the breeding grounds at QUBS. We are also continuing to study the trade-offs between reproduction, molt and migration. On our 60 ha forested plot, we captured and marked individuals upon arrival, monitored reproductive success, and measured territory quality through insect and vegetation sampling. We use stable-light isotopes to track molting location and the quality of winter habitat used during the non-breeding season in the tropics.

Ryan Norris – **"Geographic connectivity and seasonal interactions in a long-distance migratory bird"** - Ph.D Thesis

This was my fourth and final year of data collection for my thesis. In 2004, I undertook two primary projects. First, I continued to sample feathers from returning Redstarts to examine the trade-offs between reproduction (measured in year X-1), molt (feather replacement in year X-1) and feather colour (in year X). Second, I continued to monitor the reproduction of this population in order to examine how the annual variation in tropical winter habitat quality affects reproductive success and recruitment of young.

Assistants: Andrea Flowers, Jean Humphries

Katie Langin – “Are Neotropical-Nearctic migrant songbirds capital or income breeders? Evidence from stable isotopes” – B.Sc. Thesis

Birds can meet the energetic demands of egg formation by utilizing body stores (capital breeding) or recently ingested nutrients (income breeding). I used stable-carbon isotopes ($\delta^{13}\text{C}$) to determine whether American redstarts use body stores acquired on the tropical wintering grounds or during migration to form eggs. Data from yolk samples collected in 2003 suggested a possible winter origin of egg nutrients, as there was an isotopic shift in $\delta^{13}\text{C}$ values across clutches laid by the same female. However, diet analysis through sampling female blood plasma in 2004 indicates the yolk isotopic shift is reflective of a diet shift, which points to an income breeding strategy.

Assistants: Andrea Flowers, Jean Humphries

Theses:

- Norris, Ryan. 2004. Geographic connectivity and seasonal interactions in a long-distance migratory bird. Ph.D. Thesis, Queen's University.
- Katie Langin. 2004. Are Neotropical-Nearctic migrant songbirds capital or income breeders? Evidence from stable-isotopes” B.Sc. Thesis, Queen's University

Publications:

- Norris, DR. 2005. Habitat quality and carry-over effects in migratory populations. In press: *Oikos*.
- Norris, DR, Marra PP, Kyser, TW, and Ratcliffe, LM. 2005. Tracking the habitat use of a long-distance migratory bird using stable-carbon isotopes in cellular blood. In press: *Journal of Avian Biology*.
- Norris, DR, Marra PP, Montgomery, R., Kyser TK, and Ratcliffe, LM. 2004. Reproductive effort, molting latitude and feather color in migratory songbird. *Science* 306:1249-1250.
- Marra, P.P., Norris, D.R., Haig S.M., Webster, M., and Royle, A. In Press. Migratory Connectivity. In: *Maintaining Connections for Nature*. (Kevin Crooks and Muttulingam Sanjayan, eds.). Oxford University Press.
- Norris, DR, Marra PP, Kyser TK, Sherry, TW, and Ratcliffe, LM. 2004. Tropical winter habitat limits reproduction success in a migratory bird. *Proceedings of the Royal Society, London B* 271:59-64.

Dr. Raleigh J. Robertson - Department of Biology

"Behavioural Ecology and Conservation Biology of Birds"

The 'RJR Bird Lab' field program in 2004 focused on Tree Swallows, Cerulean Warblers and Golden-winged Warblers, plus some collaborative work on Barn Swallows. The **Tree Swallow** studies consisted mainly of maintaining our nest-box grids and monitoring nesting success. This work was done by SWEP student, **Amy Cameron**. The **Cerulean Warbler** work marked the beginning of regional survey work to determine the extent of breeding Ceruleans, especially in the fragmented forests in the Elgin and Portland areas, plus some continued banding and monitoring of the Bedford Mills Road population. **Kate Girvan** headed the Cerulean team, with the able assistance of **Erik Coleman** and **Amy Cameron** who did extensive point-count work. The **Golden-winged Warbler** project involved some continued work by **Rachel Fraser**, an honours thesis project by **Lauren Reed**, and an expansion of the project to include an M. Sc. study for **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**, plus Queen's honours thesis student **Sylvia Wood**, being supervised by RJR.

Golden-winged Warbler Studies:

Rachel Fraser - “Examining the genetic architecture of a newly formed hybrid zone between Golden-winged and Blue-winged Warblers” - Ph.D. Thesis

During the summer of 2004 Rachel worked with Kevin Fraser and Lauren Reed studying Golden-winged Warblers at QUBS. Field work involved finding, capturing and banding adult birds, locating nests, as well as collecting blood samples from adult birds and nestlings, and mapping nests sites using the GPS. This year we found a record number of 49 nests. This is the highest number of Golden-winged nests ever found in one breeding season in any North American population! Blood samples collected from adult and nestling birds are being used in genetic analyses that are examining the level of genetic purity of this species in the QUBS area. Given the ongoing hybridization with the Blue-winged Warblers, it is imperative for conservation of the Golden-wings that genetically pure populations are identified. This is especially pertinent when you consider that numbers of Blue-wings and hybrids have been increasing in the QUBS area in recent years. It is our hope that these data will ultimately help explain the affects of widespread hybridization between Golden-winged and Blue-winged Warblers on Golden-winged Warblers breeding throughout Canada and the north-eastern United States.

Assistants: Kevin Fraser and Lauren Reed

Kevin Fraser - “Migratory connectivity, hybridization, dispersal and conservation in Golden-winged warblers” – M.Sc. Thesis

In the Spring and Summer of 2004, Kevin worked with Rachel Fraser and Lauren Reed to study the Golden-winged warbler during the breeding season. Throughout this period, the group captured, banded, and took small feather samples from adult birds. These samples will be examined using stable isotope analysis, to determine a wintering latitude in Central and South America for birds breeding at QUBS. This analysis will be combined with that of feathers collected in Manitoba, Tennessee, West Virginia and on the wintering ground in Costa Rica, Honduras, and Venezuela to establish linkages between various breeding and wintering populations. This information may be used to establish important conservation links and protection for this rapidly declining species throughout their yearly cycle.

Lauren Reed - “Are hybrids good parents? Investigating feeding rates in an introgressed population of Golden-Winged Warblers” – B.Sc. Thesis

My research questions aim to compare pure Golden-Wing pairs and their nestlings to those of mixed hybrid pairs. I hope to answer: how feeding rates, nestling condition, and clutch size compare between and within the two groups. I handled about 100 birds for my part of the GWWA study, most of them nestlings that we banded and took blood from as well. I do not have results yet; I am still working on my statistical analyses

Barn Swallow Studies

Oddmund Kleven – “The function of extrapair fertilization in passerine birds” – Ph.D. Candidate, University of Oslo, Norway in collaboration with Dr. Raleigh Robertson, and under the supervision of Dr. Jan Lifjeld, University of Oslo. (see pp. 51 and 52)

Assistants: Frode Jacobsen and Sylvia Wood

Sylvia Wood – “Patterns of Inter and Intra clutch egg size variation with Respect to Female Condition in Barn Swallows, *Hirundo rustica*” – B.Sc. Thesis

My work at the QUBS focused on studying the reproductive ecology of North American Barn Swallow in relation to patterns in both inter- and intra-clutch size variation, as well as the impact of differing amounts of pre-

laying maternal investment on a female's investment in future clutches. To carry out this research I caught, banded and took measurements of all individuals at four colony sites both on and off (with the permission of the Ontario Ministry of Transport) Queen's property using mist nests. At each site I identified mating couples, their nests and followed egg-laying within each nest for the duration of both a breeding pair's first and second clutches (May 1-July 15, 2004). Laying order was tracked in each nest and egg size measurements taken two days after the completion of egg laying. At three sites clutches were removed after measurement to induce early relaying and to truncate investment in first clutches thereby reducing female energy expenditure of rearing. With these data I am hoping to find patterns of egg size variation within clutches corresponding to Slagvold *et al.*, (1984) "Brood Survival Strategy" in which egg size (volume) increases with laying order. As well I expect that females who have their clutches removed early in the breeding season to re-lay larger second clutches than control females as a result of truncated energy investment in their first clutch. At present I have no final results to present.

Tree Swallow Studies

Amy Cameron – "Long term Tree Swallow study at QUBS" - Field assistant

The breeding season of 2004 was used only for continued monitoring of the nest box population of Tree Swallows at the Queen's University Biological Station. Nests were checked regularly and adults and nestlings were banded to record nesting success and nesting location. A bout of predation on nest-boxes by Common Ravens, that learned to open the doors to the boxes, greatly reduced nesting success this year.

Cerulean Warblers

Kate Girvan, Erik Coleman & Amy Cameron – "Cerulean Warbler Habitat Requirement Study"

The 2004 field season was the first of a proposed five-year research project to examine area sensitivity of Cerulean Warblers. During May and June, with a field crew of Amy Cameron, Eric Coleman and Kate Girvan, we conducted a total of 64 point counts in 58 forest patches within a 10 x 10 km square area in the County of Leeds and Grenville (10-20 km east of the Queen's University Biological Station, and the well-studied Bedford Mills Road population of Cerulean Warblers). The 58 forest patches surveyed represented all the forested areas >5 ha in size within the study plot. Within these forest patches, we did point counts only in habitat that appeared suitable for Cerulean Warbler occupation. Point count teams also used an omni-directional microphone and recording system to provide an archive of the data and an opportunity for verifying questionable identifications.

Cerulean Warblers were detected in only 3% of the point counts (2/64), in 2 forest patches. The two patches found to have Cerulean Warblers were 128 ha, and 239 ha in size and represented some of the largest available forest tracts in this study area. In fact, since these two patches were only separated by a road allowance, they may be considered one continuous patch, making the total patch size 367 ha (128 ha + 239 ha).

Cerulean Warblers were banded at these forest patches, as well as at the long-term Bedford Mills Road Cerulean study, by using playback of Cerulean song accompanied by models of singing males, to attract males into mist nets. A total of 24 territories were monitored daily for mating and breeding success. Thirty-three Cerulean Warblers were caught and color banded this year, including 5 females, 1 hatch year, and 17 males. 12 Nests were found and monitored for reproductive success.

Publications

Jones, J., J. J. Barg, T. S. Sillett, M. L. Veit, and R. J. ROBERTSON. 2004. Minimum estimates of survival and population growth for Cerulean Warblers (*Dendroica cerulea*) breeding in Ontario, Canada. *Auk* 121: 15-22.

Theses:

Neville, K.J. 2004. Nestling sex ratios of Golden-winged Warblers (*Vermivora chrysoptera*): Is there evidence of a cost to hybridization. B.Sc. Honours thesis, Queen's University. Supervisors: Dr. Raleigh Robertson and Rachel Fraser

Dr. Rowland Tinline - Department of Geography and Geographic Information Systems Lab

Caleb Hasler- “Quantification of associations between acoustically tagged Largemouth Bass (*Micropterus salmoides*) during a five day period in winter 2004” - B.Sc. Thesis

In the past, associations between fish have been difficult to quantify because data at appropriate spatial-temporal scales have not been available. My research in the fall and winter 2004/05 focused on using fine scale acoustic telemetry data collected at the Warner Lake Ecological Observatory (WLEO) to quantify associations between tagged largemouth bass. This newly installed system has allowed fish positions to be monitored continuously with meter precision in the spatial domain and typically at 15- 30 second resolution in the temporal domain. Data were queried and mined to produce average locations for the tagged fish every hour for the time period ranging from January 01 to January 05, 2004. Initial results suggest that associations between the observed largemouth bass are not random and some fish associate more with certain fish than other fish. More research is required to see how consistent those associations are over time and to determine what factors may be driving them.

Collaborators: Kyle Hanson, Dr. Steve Cooke, Dr. Cory Suski, Dr. George Neizoda and Dr. Dave Philipp

Dr. Bruce Tufts - Department of Biology

“Evaluating the Potential to Minimize Physiological Disturbance Associated with Live-release Angling Tournaments for Largemouth Bass, Smallmouth Bass and Walleye”

The practice of releasing fish following angling (catch-and-release) has increased dramatically in the past few decades. The rise in popularity of catch-and-release has been partially due to the increasing popularity of live-release angling tournaments. While releasing fish following normal angling does not typically result in mortality, studies have documented that mortality of fish following tournaments can occur. Our lab has previously been interested in the physiological responses of largemouth bass, smallmouth bass and walleye to the challenges associated with catch-and-release angling. Recently, we have begun to examine the physiological disturbances that arise in largemouth bass, smallmouth bass and walleye during live-release angling tournaments. The goal of our research is to minimize the physiological disturbance associated with angling and angling tournaments, and to maximize the survival of fish caught during these events.

Cory Suski – “A physiological examination of competitive angling events” – PhD Thesis

Live-release angling events present fish with a number of different challenges. During a tournament, largemouth bass are exposed to a number of situations where they may encounter sub-lethal concentrations of ammonia, the effects of which are largely unknown. Research at QUBS in the summer of 2004 focused on ammonia excretion rates, uptake of ammonia, and effects of ammonia on recovery from exercise in largemouth bass. In addition, experiments were performed to quantify the effects of angling tournament conditions on physiological disturbances in largemouth bass.

Assistant: Kevin Esseltine

Publications:

- Suski, C. D., S. S. Killen, J. D. Kieffer and B. L. Tufts. Provisionally Accepted. The influence of environmental temperature and oxygen concentration on the recovery of largemouth bass from exercise: implications for live-release angling tournaments. *Journal of Fish Biology*.
- Morrissey, M. B., C. D. Suski, K. R. Esseltine and B. L. Tufts. Provisionally Accepted. Incidence and physiological consequences of decompression in smallmouth bass (*Micropterus dolomieu*) after live-release angling tournaments. *Transactions of the American Fisheries Society*.
- Suski, C. D., S. J. Cooke, S. S. Killen, D. H. Wahl, D. P. Philipp and B. L. Tufts. 2005. Behaviour of walleye *Sander vitreus* and largemouth bass *Micropterus salmoides* exposed to different wave intensities and boat operating conditions during livewell confinement. *Fisheries Management and Ecology* 12:19-26.
- Suski, C. D., S. S. Killen, S. J. Cooke, J. D. Kieffer, D. P. Philipp and B. L. Tufts. 2004. Physiological significance of the weigh-in during live-release angling tournaments for largemouth bass. *Transactions of the American Fisheries Society* 133:1291-1303.



A Great Grey Owl scans the Curtis Beaver Meadow beside the QUBS access road. Great Greys were unusually abundant south of the boreal forest in the winter of 2004 – 2005. (© Jennifer Foote, February 2005)

Research Conducted by Non-Queen's Personnel in 2004

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

"Thermal Ecology of Reptiles"

The general goal of my research program is to understand how temperature affects the ecology of reptiles. The cost-benefit model of thermoregulation predicts that thermoregulatory effort should be highest in habitats of high thermal quality because the cost of thermoregulating is low. My work on black rat snakes suggests the opposite, probably because the cost of not thermoregulating is high in habitats of low thermal quality. I seek to understand how the costs and benefits of thermoregulation, in particular the thermal quality of habitats, influences thermoregulatory effort by reptiles. I am also interested in the conservation of reptiles.

Since 1996, I have also been involved in a long-term study of black ratsnakes with Patrick Weatherhead (University of Illinois). The current goals of this study are to document the effects of global warming on the demography of ratsnakes. The fieldwork we conducted at QUBS in 2004 had 2 objectives relevant to the above goals. (1) Continue the long-term demographic study of the black ratsnake population. (2) Recapture some of the 1600 neonates marked and released since 1996.

Assistants: Ariane Blouin, Serge Duchesneau, Catherine Verreault

Acknowledgements: OMNR, PC, NSERC

Laura Bjorgan - "Ontogenetic shifts in habitat use and movement patterns of ratsnakes"- M.Sc. Thesis (unofficially co-supervised by Patrick Weatherhead)

My work at the QUBS focuses on ontogenetic differences in the movement patterns and habitat use of the federally threatened black ratsnake. The goals of this research are (1) to enhance our understanding of ontogenetic processes in terrestrial species and (2) to contribute to the design of conservation efforts for the black ratsnake through the identification of critical habitat for juveniles. My work during this past summer included following juvenile black ratsnake movements using radio telemetry and identifying habitat preferences through habitat characterization of snake locations.

Assistant: Serge Duchesneau

Acknowledgements: OMNR, PC, NSERC

Grégory Bulté - "Thermal and spatial ecology of the common map turtle" - M.Sc. Thesis

My primary goal is to quantify thermoregulation patterns of the common map turtle and to relate these patterns to the extreme female-biased sexual size dimorphism present in this species. I also want to characterize sex and age specific movement patterns as well as home-range size by tracking individuals during the whole active season. During the first field season of this study, I radio-tracked 15 turtles and marked 387 individuals as part of a demographic study.

Assistants: Serge Duchesneau

Acknowledgements: PC, FCAR, NSERC

Alana (Lana) Edwards - "Thermoregulation of painted turtles in habitats differing in thermal quality" - M.Sc. Thesis

I have been studying the thermal ecology of painted turtles, examining how the investment in thermoregulation varies through the season. The data are collected with thermosensitive radiotelemetry and

miniature temperature data-loggers implanted in the body cavity. Individuals have a radio transmitter attached to the carapace, which allows the individuals to be located and their temperature and activity recorded every 48 hours.

Assistant: Serge Duchesneau

Acknowledgements: NSERC

Jeffrey Row - "Habitat use in milksnakes" - M.Sc. Thesis

In North America and especially in Canada little is known about habitat use and life history of eastern milksnakes. In 2001 at QUBS, we began the first major radio telemetry study of this species in North America. The goals of this research are to determine habitat use at multiple scales through radio-tracking and habitat analysis. We tracked a total of 13 milksnakes this summer and collected habitat data on over 200 individual snake locations. The results from this study should help provide useful information towards any conservation efforts for this species of conservation concern.

Assistant: Serge Duchesneau

Acknowledgements: NSERC

Publications:

- Blouin-Demers, G. 2003. Precision and accuracy of body-size measurements in a constricting, large-bodied snake (*Elaphe obsoleta*). *Herpetological Review* 34: 320-323.
- Blouin-Demers, G, PJ Weatherhead & JR Row. 2004. Phenotypic consequences of nest site selection in black rat snakes (*Elaphe obsoleta*). *Canadian Journal of Zoology* 82: 449-456.
- Blouin-Demers, G, HL Gibbs & PJ Weatherhead. 2004. Genetic evidence for sexual selection in black ratsnakes (*Elaphe obsoleta*). *Animal Behaviour*, in press.
- Weatherhead, PJ & G Blouin-Demers. 2004. Long-term effects of radiotelemetry on black ratsnakes. *Wildlife Society Bulletin* 32, in press.
- Weatherhead, PJ & G Blouin-Demers. 2004. Understanding avian nest predation: why ornithologists should study snakes. *Journal of Avian Biology* 35: 185-190.
- Blouin-Demers, G & P Nadeau. 2005. The cost-benefit model of thermoregulation does not predict lizard thermoregulatory behavior. *Ecology*, in press.

Dr. Andy S. Didyk, Department of Biology, University of New Brunswick, Moncton

“Seasonal Changes in the Helminth Fauna of Little Brown Bats, *Myotis lucifugus*, in Ontario, Canada”

To test the hypothesis that intestinal parasite loads are responsive to the stresses inherent in the annual cycle (mating, hibernation, and raising young) of little brown bats, individuals were sampled in the spring when females were in nursery colonies with their young, in the summer during mating season, and early in the winter while the bats were hibernating. During hibernation, when energy reserves must be sufficient to last until the spring, parasite loads should either be very light or, alternately, the parasites may exhibit some type of adaptation as a means of coping with their host's hibernative period. Since male bats are not present at the maternal (nursery) sites in the spring, it follows that a female's parasite community should be different from males at the same time of the year while juvenile bats would be in the process of acquiring their initial parasite communities. A comparison of parasite communities at the swarming sites associated with mating in the summer should indicate the degree to which their parasite communities are similar.

This work was carried out in conjunction with a study on the genetic diversity of little brown bats at the hibernation, maternal and swarming sites being conducted by Ms. Beth Clare, a student working with Dr. Brock Fenton of the University of Western Ontario in London, Ontario. I'd like to thank Ms. Clare for her invaluable help

in the field and especially for the collection of bats from the maternal and hibernating colonies. Queen's University Biological Station (QUBS) on Lake Opinicon, north of Kingston, Ontario, served as a base for the field work undertaken in the summer of 2004. Results of the study are expected to be published late in 2005.

Dr. John Epifanio, Aquatic Biology Section, Illinois Natural History Survey, Champaign, Illinois

"Nest Site Fidelity in Colony-Breeding Sunfish"

We are interested in the role of nest site fidelity in bluegill (*Lepomis macrochirus*) as mechanism to maximize reproductive success. Reproductive success in sunfishes has been tied to nest site location (Jennings and Philipp 1993) and position within a breeding group (Gross 1981). Nest site choice contributes to the fitness by affecting the efficiency of parental care (i.e., protection of eggs and larvae), the male's access to females, and the micro-environment of nesting habitats. Males that return to a previously used location would be predicted to have greater fitness than those that nest and spawn in a novel area. Whether nesting locations are chosen either near place of birth or site of previous spawning is largely unknown. To test this relationship of fitness with nest site choice, we conducted a mark and recapture study of the bluegill population in Long Lake (located on properties owned by QUBS, Ontario) across the reproductive season (approximately June through early July in southern Ontario).

Our first goal was to locate and describe all of the prime spawning sites in Long Lake. Snorkelers swam the perimeter and searched for spawning habitats in shallow water areas (less than a meter deep). We then snorkelled those areas every two days to locate new spawning bluegill colonies. For each colony that spawned, we put numbered tags in each of the nests to identify them and mapped their location within the colony. We then captured each spawning male bluegill off of its nest using a handnet. Males were measured for length, scales removed for age analysis, and given an external fin clip to identify individual colony locations. We also marked more than 20% of the colonies with both a combination of fin clips and an individual-specific Passive Integrated Transponder (PIT) tags. We then surveyed the lake for spawning bluegill colonies every other day from early June through early July. All individuals were either marked or recorded as recaptures. Of the 309 nesting bluegill males that were marked, 80 (~25%) were recaptured during subsequent nesting episodes. While all 80 recaptured males had a colony-specific combination of fin and spine clips, 36 males also carried PIT tags, which enabled more individual specific data than was derived from the colony clips. Overall, 94% of the recaptured male bluegill returned to the same general area of the lake (basin) for subsequent re-spawning activities. Moreover, more than 90% of the respawning males were captured subsequently in a later spawning colony within a few meters of their original colony site, indicating that the male bluegill population displayed a high degree of fidelity to specific site and spawning area. While our data are consistent with the hypothesis that sunfish exhibit high levels of nest site fidelity, studies planned for 2005 will permit us to explore specifically the relationship of fidelity and fitness, as well as to determine whether there is any natal site fidelity.

Assistants: Jamie Menzel, Tasha Silich, Julie Claussen

Dr. M. Brock Fenton, Department of Biology, University of Western Ontario, London, Ontario

"Ecology of Ontario Bats; Echolocation, Gene Flow, Social Structure and Conservation"

Beth Clare - "Gene flow and social structure in the little brown bat, *Myotis lucifugus*" - B.Sc. Thesis

The level of colonial behaviour in *Myotis lucifugus* varies seasonally and by gender. Adult females form maternity colonies in spring, places where females bear and raise their young. During this time adult males appear to lead solitary lives. Beginning early in August in southern Ontario, maternity colonies break up and individuals converge at swarming sites, underground locations such as caves or mines which will serve as hibernacula. Mating occurs at swarming sites and banding records show high turnover of populations there. This general pattern of behaviour appears to provide opportunities for gene flow not suggested in the fidelity of females to nursery roosts.

The purpose of this study is to use microsatellite techniques to assess the genetic structure of populations of *Myotis lucifugus* sampled at nursery roosts, in swarming and in hibernating populations. We have sampled bats (0.5 mm diameter wing punches) from three nursery colonies (samples of 20 – 10 adults, 10 subadults) on two different days, and at three swarming populations (samples of 20 – 10 adults, 10 subadults) on two different days, and at the same sites during hibernation (10 individuals from clusters, 10 solitary).

The genetic data should allow us to determine genetic relatedness among the groups of bats sampled, and to assess gene flow between the different sites.

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

"Ecological Entomology"

This year we had several projects ongoing that are described below.

Tonia Robb - Variation in Resistance to Parasitism" - Ph.D. Thesis

This summer I completed several studies pertaining to my general thesis topic of variation in resistance to parasites by insect hosts. In the first study, I 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*. For early emerging species such as *E. boreale*, weather conditions may limit foraging and therefore may be more likely to observe costs associated with responding to parasites or pathogens. These costs may differ for males and females as life-history strategies vary (the "live hard die young" strategy of competing males versus "live long provision many eggs" strategy of females). I also completed the above study for another early emerging damselfly *Lestes disjunctus*, this time comparing if fitness costs varied with age (newly emerged versus sexually mature individuals). A second study examined whether *L. disjunctus* (a species that normally does not respond to parasitic water mites) can respond immunologically to novel water mites and whether response to familiar mites will occur during cross infections with novel parasites. Finally I continued an ongoing study on the phenology of the mite *Arrenurus pollictus* and the host *L. disjunctus* as well as examined weather-related effects on success of mites and hosts

Assistant: Jamie MacDougall

Dr. Hans Van Gossum, PDF researcher at Department of Biology, Carleton University and Evolutionary Biology Group, University of Antwerp, Antwerp, Belgium

"The evolution of polymorphism in damselflies"

Genetic polymorphisms are ideal for studying micro-evolutionary processes. In many damselfly species, females can be coloured similar to the male (andromorph) or dissimilar (gynomorph), whereby female morph is genetically determined. During the summer of 2004 we studied continental, seasonal and multi-year variation in female morph frequencies for the species *Nehalennia irene*. Our main finding is that female morph frequencies can vary far more than previously recognised. Further, our study rejects several contemporary hypotheses, and suggests future lines of research for understanding of female-limited polymorphism in these insects.

On the same lines we studied whether body coloration had implications for the likelihood on being predated upon by dragonflies. In summary, we found differences in mortality probabilities between males and females for one but not for another species. Lastly, we also studied sexual interactions in two syntopic congeners, one species showing multiple female morphs, the other being monomorphic for female. Here, we indicate that interspecific interactions may be relevant for understanding why species exhibit certain body coloration.

Assistants: Kirsten Beirinckx, Joris Gansemans, Katleen Peeters and David Lowe

Publications:

- Robb T, Forbes MR. In press. On understanding seasonal increases in damselfly defence and resistance against ectoparasitic mites. *Ecol Entomol*
- Robb T, Forbes MR. In press. Success of ectoparasites: how important is timing of host contact? *Biol Letters*
- Forbes MR, Muma KE, Smith BP. in press. Recapture success of *Sympetrum* dragonflies in relation to size, symmetry and mite parasitism. *Exp Appl Acarology*
- Baker RL, Leung B, Forbes MR. In press. Diet affects normal wing development in *Ischnura verticalis* (Coenagrionidae: Odonata). *Can Entomol*
- Lajeunesse MJ, Forbes MR, Smith BP. 2004. Species and sex biases in ectoparasitism of two dragonfly hosts by mites. *Oikos* 106:501-508.
- Rutherford P, McRuer DL, Forbes MR In press. A comparison of immune traits of baitshop and wild juvenile leopard frogs (*Rana pipiens*). *Herp Reviews*
- Robb T, Forbes MR, Jamieson IG. In press Engorgement success of parasitic mites on adult sexes of the colour polymorphic mountain stone weta. *NZ Journal of Zoology*
- Forbes MR, Rutherford P, McRuer DL. 2004. Prevalence of *Aeromonas hydrophila* in relation to timing and duration of breeding in three species of ranid frogs. *Ecoscience* 11:282-285.
- Wong A, Smith ML, Forbes MR. 2003. Differentiation between subpopulations of a polychromatic damselfly with respect to morph frequencies, but not neutral genetic markers. *Mol Ecol* 12: 3505-3513.

Theses:

- Lowe, David. 2004. Sexual colour differences in damselflies: are males more conspicuous to predatory damselflies? B. Sc. Thesis, Carleton (supervised by Drs. Hans Van Gossum and Tom Sherratt)

Dr. James H. Fullard, Department of Zoology, 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. The bat/moth flight room was back in action this summer with

new experiments with katydids (ter Hofstede) and in-flight studies on bats and clicking moths (Ratcliffe). The high-speed video facility was fully functional with studies of moth responses to bat sounds (Muma). We have moved to a completely digital sound presentation with the advent of new programmes (Walls) that will greatly increase the number of acoustic experiments that we will initiate in the future.

Hannah ter Hofstede – “Cues used by Northern long-eared bats to locate singing katydids.” - PhD thesis

Last summer, I conducted preliminary studies toward my PhD thesis on the use of passive and active defences by katydids against bats. We captured bats and katydids locally and ran experiments in the outdoor flight enclosure. Katydids (*Neoconocephalus ensiger*) and bats (*Myotis septentrionalis*) released into the enclosure were observed in darkness using a night vision scope. Singing katydids were attacked and eaten by these gleaning bats. Belwood and Morris (1987 Science 238: 64-67) proposed that differences in the duty cycles of katydids (percentage of time during singing that is occupied by sound) have evolved in response to different levels of predation pressure by gleaning bats. Gleaning bats often use prey-generated sounds as cues for locating prey, and presumably the more sound produced by the prey item, the easier it is to locate. Katydids that sing in open forest areas are more accessible to gleaning bats, and therefore should use lower duty cycle songs, than those in dense vegetation. We recorded and played back calling songs of two different katydid species (*Neoconocephalus ensiger*, high duty cycle; *Scudderia curvicauda*, low duty cycle) to foraging bats in the flight room, in addition to silence and noise controls. Bats landed on the speaker when we played the high duty cycle katydid more often than the low duty cycle katydid or any of the controls, supporting the idea that high duty cycle calls are easier for bats to locate. Next summer I plan to continue my experiments with bats and katydids to resolve questions concerning the cues used by bats to locate katydids, and the ability of katydids to detect and defend themselves against gleaning bats.

Assistant: Karrienne DeBaeremaeker

Kit Muma and James Fullard – “High resolution video analysis of moth anti-bat avoidance flight and its neural control.”

Echolocating bats emit sounds in the range of 10-50 kHz and many insects including moths, have adapted auditory structures to detect these ultrasonic calls. In a previous study we documented behavioural responses to ultrasound by a diurnal moth species by videotaping free-flying moths subjected to a loud ultrasonic pulse (Muma and Fullard 2004). These methods had their limitations in that the flight of the moth was not controlled and we were unable to correlate the exact timing of the responses to the neurophysiology of the individual moths. To study the precise neural control of flight responses to ultrasonic pulses, we videotaped moths in stationary flight using a high-speed video camera. Through frame-by-frame analysis we will be able to determine the exact timing of behavioural responses and correlate these motor responses to the sensory pathways of the auditory system. Adult moths were collected at mercury-vapour and ultraviolet lights at Q.U.B.S. between May and July 2004. We tested moths from the superfamily Noctuoidea including the members of the families Noctuidae and Notodontidae. Live moths were mounted on a thin wire by affixing melted wax to the dorsal surface of their thorax. Once the wax had hardened around the pin, the moth was suspended in a flight chamber consisted of a foam-lined Faraday cage in which a MotionScope high-speed video camera was positioned. The camera was set to record 1000 frames per second and the moth was illuminated with ultraviolet lights. While filming the moths in stationary flight we exposed them to ultrasonic pulses by using a Wavetek function generator (frequency = 25 KHz) shaped by a Coulbourn set to a period of 235 and duration of 15 msec, amplified and broadcast by a speaker positioned directly to the left of the moth. We chose these settings to mimic the calls of a cruising *Eptesicus fuscus* bat. We tested a range from 60 DB (81.7 mV) to 85 DB (2 volts) for each moth.

After the moth's flight responses had been videotaped it was immediately transferred to the auditory neurophysiology chamber where the receptor neurons of its tympanic nerve were monitored while its ears were stimulated by the identical sounds that activated its flight behaviours. The ultimate goal of these experiments is to correlate the auditory neural activity that was present during the different sequences of the moths' flight responses

thereby providing an empirical demonstration of how the simple ears of these insects directly govern specific behaviours.

John Ratcliffe - “Cues used for toxic prey discrimination in the northern long eared bat, *Myotis septentrionalis*” - PhD thesis

As caterpillars, some tiger moths (family Arctiidae) consume and sequester the toxins of host plants (e.g., milkweed). As caterpillars and moths, many of these species have warning colouration. When moths, some also produce high frequency clicks in response to the echolocation calls of bats. Multi-modal cues in dangerous prey have two plausible explanations: (1) cues are tailored to specific predators or (2) cues have an additive effect and must be experienced as a suite to be effective. To test the prediction that northern long eared bats (*Myotis septentrionalis*) use visual or acoustic cues or both to discriminate arctiid moths, in a large outdoor flight room we used 12 bats as subjects. Six bats were introduced to a situation demanding aerial hawking tactics and six other bats to a situation demanding gleaning tactics (gleaning is the act of taking prey from terrestrial surfaces). We found that during gleaning attacks neither visual cues nor acoustic cues were effective in deterring the bats from completing their attacks: moths were rejected only after the bat had had the moth in its mouth. During aerial hawking attacks we found that while acoustic cues did deter the bats, visual cues were ineffective. Our results support the hypothesis that individual cues are tailored to work against specific groups of predators.

Assistant: Karrienne DeBaeremaeker

John Ratcliffe and James Fullard – “Free-flight test of the interference hypothesis of arctiid moth clicks”

Certain tiger moths (Arctiidae) emit ultrasonic clicks when they hear the echolocation sounds of an approaching bat which cause the bat to abort its attack. An alternative theory to the aposematic (warning) hypothesis of arctiid click defence is that the sounds interfere with the echolocation processing of the bat either via a startle (surprise) or jamming (phantom echo) mechanism or both. In support of the interference theory the dogbane tiger moth (*Cycnia tenera*) has been shown to wait until the echolocation of an approaching bat indicates that it is very near to the moth (i.e., terminal attack phase). These experiments however were performed with stationary, non-flying moths using pre-recorded echolocation sounds of an attacking bat. This summer we tethered *Cycnia tenera* moths and allowed them to fly inside the flight room after which a free-flying wild-caught *Myotis septentrionalis* was released into the room. The bats made several attacks on the moth which responded as in the stationary experiments by waiting until the bats entered their attack phase. The bats in all cases aborted their attacks. While these experiments do not rule out the possibility that aposematism may be the ultimate function of tiger moth clicks they demonstrate that flying moths exposed to natural bat attacks use their sounds only in the terminal portion supporting the theory of an interference function of the sounds.

Assistant: Karrienne DeBaeremaeker

Peter Wall and James Fullard – “Burster: a PC-based, sound synthesizing and playback programme for field and lab use with laptops.”

During the summer, a Matlab application, Burster, was developed for the generation and playback of synthetic and recorded sonograms. Burster was engineered as a tool to support current practice in lab and field work. It also provides features for the creation of test suites, in which stimulus parameters can be systematically varied and presented. Currently, the application supports two channels.

Publications:

- Fullard, J.H., Ratcliffe, J.M., and Soutar, A.R. 2004. Extinction of the acoustic startle response in moths endemic to a bat free habitat. *Journal of Evolutionary Biology* 17: 856-861.
- Guignion, C. and Fullard, J. H. 2004. A potential cost of responding to bats for moths flying over water. *Canadian Journal of Zoology* 82: 529-532.
- Muma, K.E. and J.H. Fullard.. 2004. Persistence of hearing in the exclusively diurnal moths, *Trichodezia albobittata* (Geometridae) and *Lycomorpha pholus* (Arctiidae). *Ecological Entomology* 29(6): 718-726.
- Soutar, A. and Fullard, J.H. 2004. Nocturnal anti predator adaptations in Nearctic eared and earless Lepidoptera. *Behavioral Ecology* 15: 1016-1022.

Dr. Rosemary Knapp, Department of Zoology, University of Oklahoma, Norman, Oklahoma, USA

“Proximate Mechanisms of Variation in Reproductive Behavior”

During the summer of 2004, we conducted three studies related to the role of steroid hormones in mediating reproductive behavior in bluegill sunfish. Together with Dr. Bryan Neff (Univ. Western Ontario) and his students, I addressed 3 specific questions: 1) How do the different male phenotypes in bluegill differ in circulating levels of androgens and the stress steroid hormone cortisol on the day of spawning? 2) How do the testes of males practicing alternative reproductive tactics differ histologically? 3) How do androgen and cortisol levels vary across the period of paternal behavior in males of the parental morph?

During June, we collected blood, tissue samples, and morphometric data from males and females on the day of spawning from a single bluegill colony in Lake Opinicon to address questions 1 and 2. We also collected blood samples and morphometric data from subsets of males from a large colony on Days 0 to 7 of parental behavior. Our androgen data paralleled those reported previously from this population (Kindler, Philipp, Gross and Bahr. 1989. *General and Comparative Endocrinology*; androgen levels differed among the male phenotypes and declined in parental males over the period of paternal behavior. Our study this year extended Kindler et al.'s findings by now documenting that satellite and sneaker males had significantly higher cortisol levels on the day of spawning than parental males or females. For parental males, we found no significant overall differences in cortisol levels as the period of paternal behavior progressed. However, more specific analyses suggest that cortisol levels are higher during the first two days of care when fanning behavior is intense and again on the final days of paternal behavior in larger males and males tending more offspring. These intriguing findings will be pursued in more detail in subsequent field seasons. Histological analyses of testes are still in progress.

Assistants: Bryan Neff's students: Jeff Stoltz, Sarah Magee, Margaret Orlowski, Beth Clare

Dr. Jan T. Lifjeld, Natural History Museum, University of Oslo, Norway

“The Function of Extrapair Fertilization in Passerine Birds”

Oddmund Kleven - “The function of extrapair fertilization in passerine birds” - Ph.D. Thesis

The principal objective of the doctoral project is to “*reveal to what extent female birds enhance offspring fitness through extrapair fertilization*”. Usually, female birds seem to receive no direct benefits except sperm in extrapair copulation. It is therefore generally believed that females pursue extrapair copulations to achieve some form of indirect genetic benefit, but very little empirical evidence for any such benefits exist.

One of the sub-goals, which applied to the barn swallow study at QUBS in 2004, was to “*test whether females engage in extrapair copulations to improve offspring heterozygosity*”. It has been hypothesised that females

mate multiply to increase the heterozygosity of their progeny, since heterozygous individuals are assumed to have a fitness advantage. Females can maximise heterozygosity of their offspring by mating with genetically unrelated and/or heterozygous males. Since females in socially monogamous species may be constrained in their mate choice they might end up with a genetically sub-optimal male. Hence, it has been suggested that extrapair copulations could be a way for females to circumvent this restriction on mate choice and thereby increase the genetic quality (e.g. heterozygosity) and the fitness of their offspring. If females engage in extrapair copulations to increase offspring heterozygosity, one would expect extrapair young to be more heterozygous than their within-pair half-siblings.

The field work took place in five breeding colonies of barn swallows located in the district around QUBS during the period ultimo April until ultimo July.

Assistants: Frode Jacobsen and Sylvia Wood

Dr. Scott A. MacDougall-Shackleton - Departments of Psychology and Biology,
University of Western Ontario, London, Ontario

“Integrative Studies of Birdsong”

Our research addresses the mechanistic bases of birdsong production and perception, as well as the reproductive and population-level effects of variation in singing behaviour.

Jeremy Pfaff – “Song Repertoire Size and Male Quality in the Song Sparrow (*Melospiza melodia*)” – M.Sc. Thesis

Male song sparrows sing from 5 to 13 different variants of their species-typical song (song repertoire). In captivity female song sparrows exhibit greater sexual responses to a playback of many song types than to playback of few song types. We are conducting a long-term study of song repertoires and male quality in a population of song sparrows breeding on the Bracken Tract. This involves i) recording the entire song repertoires of the local males, ii) locating nests and collecting DNA samples from males, females and nestlings, iii) collecting blood samples for parasite analyses, and iv) taking morphological measures to evaluate physical measures of quality. This research will allow us to determine if behavioural preference for large song repertoires seen in the lab actually lead to increased reproductive success in the field.

Assistant: Mariechen Reifese

Alexandra Hernandez – “Song Learning and Geographic Song Preferences in Female Song Sparrow (*Melospiza melodia*)” – Ph.D Thesis

Male songbirds learn to sing through a process of imitative vocal learning. Presumably female songbirds also learn to recognize their species' songs, but this is much less studied. Females of many species of songbird exhibit sexual preferences for the songs of the local geographic area rather than songs from a more distant area. We are assessing whether these geographic song preferences are learned by hand-rearing baby song sparrows captured at QUBS and near London Ontario. Half the birds from each location will be tutored with songs from their genetic place of origin, and the other half will be tutored with songs from the other location. Once sexually mature, all birds will be tested for their song preferences.

Assistants: Stuart Smith, Tyler Stevenson, Andrea Veale

Publications:

Hernandez, A.M. & MacDougall-Shackleton, S.A. 2004. Effects of early song experience on song preferences and song-control and auditory brain regions in female house finches (*Carpodacus mexicanus*). *Journal of Neurobiology* 59: 247-258.

Theses:

Pfaff, J.A. (2003) Song repertoire size and male quality in the song sparrow (*Melospiza melodia*). B.Sc. Thesis, University of Western Ontario

Dr. Gerald L. Mackie, Dept. of Zoology, University of Guelph, Guelph, Ontario.

“Fish Host Determination of Endangered Freshwater Mussels in Southwestern Ontario, Canada”

The Sydenham River in Southwestern Ontario hosts an abundance of rare species, some of which are unique to Canada. This study focuses on population surveys and fish host determination studies of endangered freshwater mussels in Southwestern Ontario. Gravid females of *Villosa fabalis*, *Epioblasma torulosa rangiana*, *Epioblasma triquetra*, and *Lampsilis fasciola* were collected from the Sydenham, Grand, and Thames Rivers in southwestern Ontario. The females were collected and used for fish infestation experiments in the Hagan Aqualab at the University of Guelph. The fish were collected from the Eramosa, Speed, and Thames Rivers, Cox Creek, Correctional ponds in Guelph, Court drain, Wye Creek, Grindstone Creek, Rideau Lake, and Lake Opinicon (Queen’s University Biological Field Station) were the rivers and lakes chosen for collection of fish. These water bodies were selected because of their location (i.e. close to Aqualab) and the range of fish species and sizes present. Seine nets, minnow traps, small hand nets, and electro-fishing gear were used to collect the fish.

Villosa fabalis juveniles developed on *Percina caprodes* (Logperch), *Culaea inconstans* (Brook stickleback), *Etheostoma caeruleum* (Rainbow darter), *Etheostoma nigrum* (Johnny darter), and *Etheostoma blennioides* (Greenside darter). Juveniles of *Epioblasma torulosa rangiana* developed on *C. bairdi*, *E. exile*, *Percina maculata* (Blackside darter), *E. nigrum*, and *E. caeruleum*. Juveniles of the *Epioblasma triquetra* species transformed on *P. caprodes*, *Micropterus salmoides* (Largemouth bass), *Etheostoma exile* (Iowa darter), and *Cottus bairdi* (Mottled sculpin). Juveniles of *Lampsilis fasciola* transformed on *M. salmoides*, *C. bairdi*, *C. inconstans*, and *Micropterus dolomieu* (Smallmouth bass). Forty-two combinations of 15 fish species and four unionid species were tested. To date the 2004 infestation experiments have resulted in a success rate for fish host identification of approximately 43% (18 out of 42), which is over our 2003 and 2002 success rates of 20% and 15%, respectively. Experiments are still in progress and based on previous infestations, it is expected that more juveniles will develop for the *E. triquetra* and the *E.t. rangiana*. Hence, it appears that we can expect between 15% and 45% of any infestations to prove positive (i.e. a fish host will be identified) for the remaining fish species.

Assistants: Lab technician: Kelly McNichols

Summer Students: Jessica O’Neill and Rebecca Dolson

Publications:

McNichols, K.A. and Mackie, G.L. 2003. Fish Host Determination of Endangered Freshwater mussels in the Sydenham River Ontario, Canada. Final Report for a study funded by Endangered Species Recovery Fund in 2003. 26pp.

McNichols, K.A. and Mackie, G.L. 2004. Fish Host Determination of Endangered Freshwater mussels in the Sydenham River Ontario, Canada. Final Report for a study funded by Endangered Species Recovery Fund in 2004. 25pp.

Dr. Bryan D. Neff, Department of Biology, University of Western Ontario, London, Ontario

"Mating Systems in Fish"

My lab works on fish mating systems. During the summer of 2004 three projects were conducted by my graduate students, which are summarized below. Additionally, this year my lab began a collaboration with Dr. Rosemary Knapp, University of Oklahoma, to investigate the endocrinology of parental care in bluegill sunfish (*Lepomis macrochirus*). UWO undergraduates Beth Clare and Margaret Orłowski provided valuable field assistance.

Jeff Stoltz - "Sperm competition and its evolutionary consequences in fishes" - MSc Thesis

We investigated the factors influencing fertilization success during sperm competition between males with alternative mating tactics in the bluegill sunfish. Previously, it has been shown that parasitic males (called sneakers and satellites) are superior sperm competitors to larger, nest tending males called parentals. We show that differences in timing of sperm release, number of sperm released and proximity of males to eggs during ejaculation can explain competitive differences. Also, we determine how ecological and phenotypic attributes affect sperm competitiveness.

Sarah Magee - "Costs of parental care in bluegill sunfish" - MSc Thesis

Parental care theory states that energetic investment in current offspring comes at a cost of reduced future reproductive potential. However few studies have demonstrated such an "ultimate" cost. Instead most studies have measured "proximate" costs, such as weight loss or depletion of lipid reserves during the care period, and used these to infer an ultimate cost. Recently researchers have focused on circulating hormone levels during the reproductive period as a measure of proximate costs of parental care. My research investigates proximate costs of parental care in bluegill sunfish and attempts to link these costs to reduced reproductive potential. Specifically, I used an experimental manipulation of brood size to alter parental care behaviour and I monitored parental effort, weight loss and circulating hormones of parental males throughout the care period as proximate measures of cost. I tracked the reproductive success of these males through future spawning attempts to assess ultimate costs. I predict that males with larger broods will have paid higher proximate costs of parental care as well as higher ultimate costs, i.e., had lower reproductive success in subsequent broods.

Tim Hain - "Altruism, mate choice and the evolution of kin recognition" - MSc Thesis

The ability to recognize kin is important in the context of both altruism and mate choice. First, because altruistic behaviours are costly, it is important that individuals be able to direct help toward relatives and avoid helping unrelated individuals. To obtain benefits of living in a kin group, individuals are expected to discriminate between kin and non-kin by preferentially associating with related individuals. Second, because offspring from matings between related individuals commonly have reduced fitness, kin recognition is important in the context of mate choice. My research examines the use of kin recognition by bluegill sunfish in the context of altruism, and by guppies (*Poecilia reticulata*) in the context of mate choice. In bluegill, I investigate the benefits of living with kin, and test if larvae profit from kin selection by preferentially associating with kin versus non-kin.

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

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 groups 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 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, Steve Cooke, Kyle Hanson, Anne Readel, Deanna Iwaniec, Jamie Menzel

Brandon Barthel - "Factors influencing individual and population level reproductive success of smallmouth bass, *Micropterus dolomieu*" - PhD Thesis

This project has monitored reproduction of smallmouth bass inhabiting a connected river-lake section of the Mississippi River since 1996. Snorkeling surveys have visually followed the reproductive success of each nesting male bass in each year. In addition, each individual nesting male has been captured and given a unique tag, allowing us to follow the reproductive history of individual males through multiple years. Tissue samples are collected from nesting males, broods, and one year old juveniles to be used in paternity studies that will improve our understanding of population-level recruitment mechanisms acting on the fish of the system. Visual observations and microsatellite DNA techniques will provide the resolution to determine the reproductive contribution of individual males to the population in each year and through their lives. This data will provide insight into what factors (biotic, abiotic) are affecting the success of individual males, and provide further resolution to our understanding of recruitment mechanisms. We observed a moderate number of males nesting in the system in 2004 (115 nests) relative to previous years. Nesting success was also high due to relatively stable environmental conditions during the reproductive period. Tissue samples collected are undergoing laboratory analysis through the year.

Assistants: Deanna Barthel, Anne Readel, Jamie Menzel, Jim Ludden

Kyle Hanson - "Assessment of largemouth bass *Micropterus salmoides* behavior and activity at multiple spatial and temporal scales utilizing a 3-D whole-lake ecological telemetry observatory" - M.Sc. 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. After initial deployment and testing, the array has now been donated to the Queen's University Biological by Lotek

Wireless Inc. and has been termed the Ecological Observatory. The current study has been used to analyze bass behavior at unprecedented spatial and temporal scales. In November of 2003, 23 acoustic transmitters were implanted in largemouth bass in the lake. These fish were continuously tracked by the hydrophone array until April of 2004. Preliminary data analyses have consisted of comparing daily and hourly distances traveled by individual bass as well as instantaneous swimming speeds utilized by all individuals across three dates representing the three seasons encompassed by the data set (fall, winter, and spring). A positive correlation to water temperature has been noted thus far.

A more in depth analysis into the relationship between depth, temperature, and area utilization across the entire season is currently in progress.

Assistants: Brandon Barthel, Steven Cooke, Kevin Esseltine, Anne Readel, Jeff Stein, Cory Suski

Kyle Hanson - "Effects of Different Angling Practices on Post-Release Behavior of Nest-Guarding Male Black Bass"

This study sought to advance the knowledge of short-term post release behavior of nest guarding male black bass (*Micropterus* spp.) subjected to different angling practices. Male largemouth bass *M. salmoides* and smallmouth bass *M. dolomieu* were angled from their nests and subjected to treatments designed to simulate common angling practices associated with fishing tournaments and with catch-and-release angling. In addition, some nests had broods devalued during the angling treatments to simulate predation of offspring during the angling event. After capture, released fish were then tracked via visual floats attached to their dorsal fin to assess their behavior post-release. Fish subjected to procedures simulating fishing tournaments (including a one hour livewell confinement and release 100m from the nest) exhibited significantly longer rest periods prior to returning to their nest than did other treatment groups. This rest period was longer for largemouth bass than smallmouth bass. Abandonment rates for largemouth bass were usually greater than for smallmouth bass for each of the treatments, and largemouth bass seemed to abandon their nests sooner than smallmouth bass. Air exposure increased abandonment rates, but did not seem to affect return times to the nest. These results show that sublethal stressors inherent in various angling practices may impair the ability of male black bass to return to its nest quickly, thereby allowing for increased brood predation and increased chances that the nest will be abandoned.

Assistants: Brandon Barthel, Steven Cooke, Kevin Esseltine, Anne Readel, Jeff Stein, Cory Suski

Dr. Thomas N. Sherratt - Department of Biology, Carleton University, Ottawa, Ontario

"Evolution and Maintenance of Mimicry and Warning Signals in Insects"

After finishing a successful winter project in the lab, Arash Rashed (Ph.D. Student, Carleton) and Christopher Beatty (Ph.D. Student, Carleton) started their second summer project at QUBS. One project was initiated and the other one successfully completed during the field season. These projects mainly investigated the evolution and maintenance of mimicry and warning signals in insects, and more particularly hoverflies and damselflies.

Dr. David Wilkinson - (Liverpool John Moores University, UK) - Visitor

Dr. David Wilkinson visited the Behavioural Ecology Lab at Carleton University in summer 2004. During that time he was very kindly helping the lab in collecting the data, and also at the same time was looking at the mushroom species present at the Biological Station.

Arash Rashed- “Invertebrate predation and the evolution of mimicry in hoverflies” -Ph.D. Thesis

Vertebrate predators, in particular birds, are widely considered as the most important agent generating selection for warning signals in defended prey, and promoting the evolution of Batesian mimicry. However the possibility that invertebrate predators may have played a role in shaping the evolution of protective coloration has long been recognized. Arash's research at QUBS in summer 2004 was continued to investigate the implication of invertebrate predation for the evolution of mimicry in hoverflies (Diptera: Syrphidae). In this study both pair-wise and single presentation methods were used in order to evaluate the response of dragonflies in the field to warningly-coloured and mimetic natural and artificial prey. Overall, dragonflies did not show any tendency to avoid either of the imperfect wasp mimics *Toxomerus geminatus* (Diptera: Syrphidae) or *Eristalis transversa* (Diptera: Syrphidae). Similarly, dragonflies showed a non-significant difference between the number of attacks on small black and yellow-striped beads compared to small black-painted beads. Moreover, dragonflies did not attack either of the black painted or mock painted (black and yellow painted) wasps, *Vespula arenaria* (Hymenoptera: Vespidae). However, the results of our prey size experiments showed a significant tendency in dragonflies to take small size prey types (5-7mm).

The results of our experiments during 2003 and 2004 field seasons showed no evidence to support the contention that warning signals and mimicry protect small insect prey from attack by dragonflies.

Assistant: David Lowe

Christopher D. Beatty- “ The evolution of warning signals in Coenagrionid damselflies” - Ph.D. Thesis

Chris' research was continued at QUBS in the summer 2004, in order to investigate the evolution of warning signals in *Nehalennia irene* (Odonata: Coenagrionidae). Damselflies in the family Coenagrionidae (Insecta: Odonata) are characteristically sexually dimorphic, with conspicuously coloured males and predominantly drab females. Sexual dimorphism is commonly explained as a consequence of selection on traits that increase male attractiveness to females. However, males of these damselflies are nonterritorial and do not engage in displays, with male competition for mates resembling a “scramble”. Furthermore, females of many of these species are polymorphic, with one form (the “andromorph”) resembling the male. Another explanation for the sexual differences in colouration within these species has been suggested: that sexual dimorphism has evolved in this group primarily as a form of sex-related warning colouration. We tested this suggestion by comparing the survivorship of males of the species *Nehalennia irene* that had been painted in such a way as to make them look similar to an unaltered male (painted blue), simply different from the male (painted orange) or more like the gynomorphic female (painted black). We found that in cage experiments with painted males and females that blue-painted males have significantly lower harassment by other males than black-painted males. No significant difference in survivorship in the different male morphs was found over 24 and 48-hour experiments. A second set of experiments, in which painted males of a single type were placed in cages with unpainted males and females suggests a possible higher survivorship for blue painted males, although these results need to be verified with further experiments. These results suggest that males are differentially harassed based on their colouration, but we are unable to state definitively that this differential harassment equates to differential survivorship.

Assistant: David Lowe

David E. Lowe- “Sexual colour differences in damselflies” - B.Sc. Thesis

In pond damselflies (Zygoptera: Coenagrionidae), males often exhibit more colourful markings than females. These markings can be very inconspicuous, such as the small blue spot on the last abdominal segment of male *Nehalennia irene*, or very conspicuous, such as the blue and black colouration that covers males of many species of *Enallagma*. In this experiment, males and gynomorphs of both *N. irene* and *Enallagma* were presented on a thread to dragonfly predators to determine if greater conspicuousness translates into higher predation rates.

Additional observations were made to determine if prey activity, weather conditions, and presentation methods influence predation rates. Predators and prey were also analyzed to determine if dragonflies prefer to attack particular damselfly morphs. No difference was found in attack times on *N. irene*, but male *Enallagma* were attacked faster than conspecific gynomorphs, indicating a higher fitness cost for bright colouration. Prey activity and weather conditions did not affect attack times, but damselflies tied to thread around the neck were attacked faster than those tied around the abdomen. No evidence was found of dragonflies preferring particular damselfly morphs, but *Enallagma* males were rejected at a higher rate than expected, thus reducing the fitness cost of a higher attack rate.

Publications:

- Beatty, C. D., R. S. Bain and T. N. Sherratt 2005. The evolution of aggregation in profitable and unprofitable prey. *Animal Behaviour* (in press)
- Beatty, C.D., R.S. Bain, T.N. Sherratt (*in press*). The evolution of aggregation in profitable and unprofitable prey. *Animal Behaviour*
- McKee, D., I. Harvey, D.J. Thompson & T.N. Sherratt (*in press*) Frequency of female colour morphs in populations of four coenagrionid damselflies (Zygoptera: Coenagrionidae). *Odonatologica*
- McKee, D., I. Harvey & T.N. Sherratt (*in press*) Behaviour of male coenagrionid damselflies towards conspecific females at the water's edge. *Odonatologica*. 33, 271-278
- Beatty C.D., K. Beirincx, T.N. Sherratt (2004). The evolution of mullerian mimicry in multispecies communities. *Nature*, 431, 63-67
- Sherratt, T.N., A. Rashed & C.D. Beatty (2004) The evolution of locomotory behaviour in profitable and unprofitable simulated prey. *Oecologia* 138, 143-150

Dr. David F. Sherry, Department of Psychology & Graduate Program in Neuroscience,
University of Western Ontario, London, Ontario

"Evolution and Ecology of Learning and Memory"

Studies of food-storing birds and brood-parasitic birds suggest that learning and memory consists in part of adaptive specializations, shaped by natural selection to deal with specific ecological problems faced by these animals. Food-storing birds in the Parid and Corvid families show long-lasting memory for large numbers of spatially-dispersed cache sites and better performance than non-storing birds on laboratory tests of spatial ability. In addition, food-storing birds have a larger hippocampus, relative to the overall size of the brain, than non-storing species. Female brown-headed cowbirds - which search for potential host nests unassisted by males - have a larger hippocampus than males, a sex difference not found in closely related non-parasitic blackbirds such as grackles and red-winged blackbirds.

My recent research has examined the role of adult neurogenesis in these specialized memory abilities. In black-capped chickadees there is a peak in the incorporation of new neurons into the hippocampus in fall, the same time that seasonal food-storing is beginning. This fall peak in hippocampal neurogenesis is not found in non-storing birds, such as dark-eyed juncos and house sparrows, that are experiencing similar fall conditions and are undergoing similar changes in diet, social system, and home range size. Brown-headed cowbirds also show a seasonal pattern of hippocampal neurogenesis, in this case a spring peak corresponding to the onset of breeding activity and the search for host nests. Current research examines how photoperiod and experience control these seasonal changes in neurogenesis and the role that recruitment of new neurons into the adult brain may play in learning and memory.

Sara Lattanzio - "Sex differences in memory and the brain in brown-headed cowbirds" -
PhD Thesis

Brown-headed 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

females than in males. At QUBS we collected cowbirds for behavioural studies of spatial ability in males and females, and to examine seasonal patterns of neurogenesis in the hippocampus.

In behavioural work, birds were trained to peck a computer touch screen to obtain food. The touch screen apparatus 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 one produces a food reward. 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. Results show that females tend to learn these tasks faster than males, and that both males and females perform better on spatial versions of the task. In neuroanatomical work, I identified new hippocampal neurons by immunocytochemical labelling using the cell division marker BrdU. Results show greater recruitment of new neurons into the hippocampus in spring than in summer in both sexes, with some indication of greater recruitment in spring in females than in males.

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

Publications:

- Hoshooley, J.S. & Sherry, D.F. (2003) The role of caching experience in survival of new neurons in the hippocampus of adult food-storing black-capped chickadees. *Society for Neuroscience Abstracts*, Program No. 720.21.
- Szekeres, B.A. and Sherry, D.F. (2003). Spatial orientation and landmark use in black-capped chickadees. *10th Annual International Conference on Comparative Cognition*, Melbourne Beach FL. Program No. 71-5 (Abstract).
- Lattanzio, S.B., Hoshooley, J.S. & Sherry, D.F. (2004) Do the greater spatial memory demands of brood parasitism in the female brown-headed cowbird (*Molothrus ater*) correspond to higher rates of hippocampal neuron recruitment? *Society for Neuroscience Abstracts*, Program No. 554.19.
- 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.
- 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.

Dr. Bruce P. Smith - Department of Biology, Ithaca College, Ithaca, New York

"Water Mite Parasitism of Aquatic Insects"

In Summer 2004, most of my research effort centered on seasonal sex ratio bias in *Arrenurus* spp. mites. From previous laboratory studies using *Arrenurus manubriator* (that foregoes larval parasitism), it has been demonstrated that individual females are consistent in sex ratio bias of their offspring throughout their life, and this bias is inherited through maternal lineages. Progeny from individual females ranges from profoundly male-biased to profoundly female-biased, with a continuous gradient between these extremes. All evidence is that there is first-male sperm precedence in *Arrenurus* spp. mites, and the generations 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.

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 have a uniform age and must have hatched within a week of each other. Presumably, there is also a seasonal shift in sex ratio among *Arrenurus* spp. with larval parasitic associations, and it should be evident as a seasonally-shifting sex ratio of mites raised off hosts at different times of the season.

To test this, I collected *Leucorrhinia intacta* dragonflies from fields adjacent to the Lindsay Lake Road at three times, representing early, mid, and late season emergence of these hosts. Engorged larval *Arrenurus reflexus* mites were removed and were raised to adult in groups representing all larvae from a given individual host. Over

1400 mites were raised from 34 hosts. The most extreme bias was that one male and 31 females were raised from one host. In no case was there a significant bias towards males. Comparing sex ratio of mites from individual hosts relative to date, they ranged from 11 unbiased : 1 biased (May 26/27th), 9 unbiased : 6 biased (June 17th), and 1 unbiased : 7 biased (July 1st). Sex ratio of mites pooled among hosts but within date shifted conspicuously: 1 : 1.02 (May 26/27th), 1 : 2.42 (June 17th), 1 : 4.64 (July 1st).

My conclusion is that sex ratio varies from being unbiased in early season to profoundly female-biased in late season. I would expect that some female *A. reflexus* produce profoundly male-biased clutches. Presumably, larval mites on an individual host are typically progeny from several different females and there are sufficiently many females producing female-biased clutches in early season, so there is no apparent bias among mites raised from one host in early season.

A second project undertaken in 2004 was the design of an underwater light trap for collecting zooplankton and watermites. The new design employs high-intensity fishing lights, and collects far larger numbers of organisms than do the standard traps based upon Cyalume chemical lights. Sincere thanks to Floyd Connor, who provided a great deal of assistance in this endeavor.

Publications:

- Bohonak, A.J., Smith, B.P., Thornton, M. 2004. Distributional, morphological and genetic consequences of dispersal for temporary pool water mites (Acari: Arrenuridae: *Arrenurus*). *Freshwater Biology* 49: 170-180
- Smith, B.P., Florentino, J. 2004. Communication via sex pheromones within and among *Arrenurus* spp. mites (Acari: Hydrachnida: Arrenuridae). *Experimental and Applied Acarology* 34: 113-125.
- Forbes, M.R., Muma, K.E., Smith, B.P. 2004. Recapture of male and female dragonflies in relation to parasitism by mites, time of season, wing length and wing cell symmetry. *Experimental and Applied Acarology* 34: 79-93.
- Lajeunesse, M.J., Forbes, M.R., Smith, B.P. 2004. Species and sex biases in ectoparasitism of dragonflies by mites. *Oikos* 106: 501-508.

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

"Long-term Studies of Snakes and Birds"

The long-term study of black ratsnakes continued in 2004. 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.

Publications:

- Blouin-Demers, G., H.L. Gibbs & P.J. Weatherhead. 2005. Genetic evidence for sexual selection in black ratsnakes (*Elaphe obsoleta*). *Animal Behaviour*, in press
- Blouin-Demers, G, PJ Weatherhead & JR Row. 2004. Phenotypic consequences of nest site selection in black ratsnakes (*Elaphe obsoleta*). *Canadian Journal of Zoology* 82: 449-456.
- Kissner, KJ & PJ. Weatherhead. 2005. Phenotypic effects on survival of neonatal northern watersnakes. *Journal of Animal Ecology*, in press.
- Weatherhead, PJ. 2005. Effect of climate variation on timing of nesting, reproductive success and offspring sex ratios of red-winged blackbirds. *Oecologia*, in press.
- Weatherhead, PJ & KW. Dufour. 2005. Limits to sexual size dimorphism in red-winged blackbirds: the cost of getting big? *Biological Journal of the Linnean Society*, in press
- Weatherhead, PJ & G Blouin-Demers. 2004. Understanding avian nest predation: why ornithologists should study snakes. *Journal of Avian Biology* 35: 1-6.
- Weatherhead, PJ & G Blouin-Demers. 2004. Long-term effects of radiotelemetry on black ratsnakes. *Wildlife Society Bulletin*, in press.

Organizer	Function	Numbers	Duration
Phyllis Yip (Queen's)	Queen's Medical Outreach Retreat and Training	22	Jan 9 - 11
Kathy Marrocco (Amherstview Public School)	Counselling and Skills Development Winter Science Camp	12	Jan 21 - 23
Jon Landon (Queen's - Education)	Outdoor Education Planning Session	2	Jan 8
Diane Lawrence (Queen's - Education)	Environmental Education Winter Resources Field Trip	14	Feb 16 - 17
Sylvia Wood (Queen's - Biology)	Queen's Program in International Development - Retreat and Training	23	Feb 28 - 29
Tyler Irving (Queen's)	Science Quest Retreat and Planning Session	11	Mar 5 - 6
Sarah Dart (Queen's - Biology)	Winter Ecology Field Trip	9	Mar 6 - 7
Dr. Raleigh Robertson (Queen's - Biology)	Bio 526 - Conservation Biology Seminars and Field Trip	16	Mar 19 - 20
Dave MacNaughtan (EOMF)	Eastern Ontario Model Forest Planning Session	3	Mar 23
Dr. Peter Boxall (U of Alberta - Natural Resources)	Acid Rain Workshop	15	April 24
Dave MacNaughtan (EOMF)	Eastern Ontario Model Forest Annual General Meeting	47	May 1
Dr. Kringin Henein (Carleton U - Biology)	Carleton University Faculty Spring Conference Field Trip	14	May 1
Jon Sweetman (Queen's - Biology)	Enrichment Mini-Course on Limnology for High School Students	21	May 5
Dan Selbie (Queen's - Biology)	Enrichment Mini-Course on Limnology for High School Students	19	May 12
Mike McPherson (MVFN)	Mississippi Valley Field Naturalists Field Trip	15	May 16
Ken Kingdon (OFO)	Ontario Field Ornithologists Field Trip	30	May 29

Summary of Conference, Field Trip and Meeting Use of QUBS in 2004

Organizer	Function	Numbers	Duration
Jim Franchetto (TI-FABR)	Thousand Islands - Frontenac Arch Biosphere Reserve Board Meeting	15	June 8
Jen Potten (Royal Military College)	Field Work Training Session for Arctic Team Researchers	32	June 11
Jim Ludden (College of DuPage)	College of DuPage Field Course	12	June 20 - 26
Larry Mackey (Queen's)	Science Discovery Field Trip	15	July 14
Sue Craig	Elgin Girl Guides Station Tour	25	July 20
T. Michael Harrison (Ottawa U - Education)	Science Teachers Field Trip and Information Session	9	July 26
Larry Mackey (Queen's)	Science Discovery Instructors Field Trip and Planning Session	6	Aug 11
Mike Shultz	Local Boy Scouts Plant Identification Field Trip and Hike	85	Aug 12
Mike Lomas	Rideau Canal Folding Kayak Flotilla 2004 Field Trip and Station Tour	9	Aug 26
Dr. Ed Kott (Wilfrid Laurier U - Biology)	Senior Undergraduate Field Course in Biology	20	Aug 29 - Sept 10
Michael Gallagher (AIESEC)	Assoc. Internationale des Etudiants en Sciences Economiques et Commerciales Field Trip and Retreat	6	Sept 10 - 11
Diane Lawrence (Queen's - Education)	Environmental Education Workshops and Field Trip	27	Sept 11 - 12
Sharon Walker (RWLT)	Rideau Waterway Land Trust Annual General Meeting and Dinner	70	Sept 17
Ted Thomas (North Park Collegiate)	North Park Collegiate (Brantford) Field Trip	27	Sept 22 - 24
Gary Rasmussen (Sydenham High School)	Sydenham High School Teachers Field Trip and Station Tour	18	Sept 24

Organizer	Function	Numbers	Duration
Brenda Schamehorn (Queen's - Biology)	Biology 302 - General Ecology Field Trip	73	Sept 24 - 26
Brenda Schamehorn (Queen's - Biology)	Biology 302 - General Ecology Field Trip	75	Oct 1 - 3
Dr. Brian Cumming (Queen's - Biology)	Biology 335 - Limnology Field Trip	27	Oct 2
Dr. Brian Cumming (Queen's - Biology)	Biology 335 - Limnology Field Trip	38	Oct 3
Doug Archibald (Queen's - Geology)	Geology 211/221 - Geological Field Methods Field Trip	20	Oct 6
Doug Archibald (Queen's - Geology)	Geology 211/221 - Geological Field Methods Field Trip	20	Oct 7
Joslynn Affleck (Queen's - Biology)	Graduate Student Orientation Weekend and Field Trip	33	Oct 16 - 17
Roxanna Beddington (CLS)	Chaffey's Lock Seniors Luncheon	47	Oct 21
Andrew Deak (Queen's)	Queen's Program in International Development Executive Retreat and Training Session	18	Oct 30 - 31
Dr. Raleigh Robertson (Queen's - Biology)	Biology 526 - Conservation Biology Seminar Session and Field Trip	13	Nov 12 - 13
Dave MacNaughtan (EOMF)	Eastern Ontario Model Forest Workshop	30	Nov 18 - 19

Friday, May 7

Dr. John Alcock (Ecology, Evolution and Environmental Science, Arizona State University, Tempe, Arizona)
"In defense of the adaptationist programme"

Wednesday, May 19

Dr. Steven Cooke (University of British Columbia) QUBS Visiting Scientist 2004
"The conservation-physiology interface"

Wednesday, June 2

Dr. Steven Cooke (University of British Columbia) QUBS Visiting Scientist 2004
"Premature migration and associated mortality in late run sockeye salmon: a mechanistic approach to understanding a complex conservation and fisheries management crisis"

Wednesday, June 9

QUBS regulars - in house "what are you up to"

Wednesday, June 16

QUBS regulars - in house "what are you up to"

Tuesday, June 22

Dr. Rosemary Knapp (Department of Zoology, University of Oklahoma, Norman, Oklahoma)
"Hormones and alternative male reproductive strategies"

Wednesday, June 30

Frode Jacobsen (Zoological Museum, University of Oslo, Norway)
"The effects of severe population bottlenecks and a reintroduction project on the genetic diversity in south Scandinavian peregrine falcons". Also pictures of local wildlife

Wednesday, July 7

John Ratcliffe (Department of Zoology, Erindale College of University of Toronto)
"The role of sound in the predator-prey relationship of bats and insects"

Wednesday, July 14

Dr. Kai Chan (Conservation Biology, Stanford University, Stanford, California)
"Predicting the effects of landscape management on tropical countryside biodiversity"

Wednesday, July 21

Caleb Hasler (Geography/Biology, Queen's University)
"Information session on the Geographic Information System (GIS) and Global Positioning System (GPS)"

Wednesday, July 28

Eugene DeShane (Ontario Ministry of Natural Resources)
"Information session on Black Bears"

Wednesday, Aug 4

Don Ross (St. Lawrence Islands National Park)
"Forest fragments and connectivity in the Frontenac Axis Region"

Wednesday, Aug 11

Dr. Brock Fenton (Department of Biology, University of Western Ontario)
"Bats: their sounds and habits"

Wednesday, Aug 18

Mike Runtz (Department of Biology, Carleton University)
"The enigmatic wolves of Algonquin Park"

Wednesday, Aug 25

Marvin Gunderman (Department of Biology, McMaster University)
"The insects: diversity of form and function"

Wednesday, Sept 1

Dr. Brian Cumming (Department of Biology, Queen's University)
"Lakes as Indicators of abrupt Climate Change on the Prairies and Western Canada"

Documentation of Research Use of QUBS in 2004 – User-Days

User	Affiliation	Principal Investigator	Post-Doc	Graduate Student	Honours Student	Assistant	Total
Aarssen	Queen's - Biology	2	-	135	95	310	542
Arnott	Queen's - Biology	2	-	4	-	4	10
Boag	Queen's - Biology	-	-	-	2	-	2
Birt	Queen's - Biology	3	-	-	9	-	12
Cumming	Queen's - Biology	1	-	-	-	4	5
Eckert	Queen's - Biology	2	-	-	37	-	39
Grogan	Queen's - Biology	2	-	-	10	10	22
Harmsen	Queen's - Biology	1	-	-	-	-	1
Keast	Queen's - Biology	77	-	-	-	-	77
Kyser	Queen's - Geology	2	-	12	6	6	26
Lougheed	Queen's - Biology	-	-	4	-	-	4
Montgomerie	Queen's - Biology	-	1	-	-	-	1
Moyes	Queen's - Biology	3	-	-	-	4	7
Ratcliffe	Queen's - Biology	6	-	41	62	133	242
Robertson	Queen's - Biology	48	-	243	224	46	561
Tinline	Queen's - GIS Lab	6	-	-	-	4	10
Tufts	Queen's - Biology	-	-	6	-	-	6
					Queen's	Subtotal	1567
Blouin-Demers	Ottawa - Biology	66	-	503	-	160	729
Cooke	UBC - Ctr Appl Cons Res	31	-	-	-	-	31
Didyk	UNB - Nursing/Biology	7	-	-	-	-	7
Epifanio	Ill Nat Hist Surv - Aq Biol	19	-	37	35	-	91
Fenton	U Western Ont - Biology	-	-	-	14	-	14
Forbes	Carleton - Biology	26	23	73	-	115	237
Fox	Trent U - Env Res Studies	-	-	2	-	-	2
Fullard	U of T (Erindale) - Biology	60	-	196	-	154	410
Knapp	U Oklahoma - Biology	14	-	-	-	-	14
Lifjeld	U of Oslo - Nat Hist Mus	-	-	71	-	76	147
MacDougall-Shackleton	U Western Ont - Psych	3	-	109	-	81	193
Mackie	Guelph -Zoology	-	-	2	-	2	4
Marra	Smithsonian Env Res Inst	-	-	21	31	67	119
Neff	U Western Ont - Biology	44	-	142	55	54	295
Philipp	Ill Nat Hist Surv - Aq Biol	57	14	124	-	142	337
Sherratt	Carleton - Biology	3	2	67	46	-	118
Sherry	U Western Ont - Psych	6	-	4	-	-	10
Shettleworth	U of T - Psychology	2	-	-	-	-	2
Smith	Ithaca Coll - Biology	75	-	-	-	6	81
Weatherhead	U of Illinois - EEE	25	-	147	-	-	172
Zanette	U Western Ont - Psych	3	-	-	-	-	3
					Non-Queen's	Subtotal	3016
					RESEARCH	TOTAL	4583

Documentation of Use of QUBS in 2004 – User-Days

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	Principal Investigator	Post-Doc	Graduate Student	Honours Student	Assistant	Total
Total Research User-Days	596	40	1943	626	1378	4583
% Queen's	26	3	23	71	38	34
% Non-Queen's	74	97	77	29	62	64
User-Days in Teaching Activities						2360
Conference, Meeting and Field Trip Use						963
Outreach Programs						998
SWEP Program						223
Other*						976
Grand Total User-Days**						10103

University Research and Teaching Rates**Board Charges - Meals only**

\$565/month/person	-no obligation for chores
\$400/month/person	-includes obligation for chores on a rotating schedule

Accommodation Charges - Housing only - no linen service

\$41/month/person	-dormitory (White House or Curran Cottage)
\$82/month	-small cabin (Cabins 1, 4, 5, 6, 7, 11 and shaker)
\$165/month	-medium cabin (Cabins 2, 3, 8, 9, 10, 13, 14)
\$225/month	-large cabin (Cabins 12, 15 and White House Apartment)
\$325/month	-Cottage (Keast, Earl, Sumac or Maplewood)

Room and Board Rates for Field Courses - no linen service

\$310/person	-weekly R&B for OUPFB field courses
\$345/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

\$35/day/person	-24 hr. room and board
\$5.75	-breakfast or lunch only
\$11.50	-dinner only
\$17.50	-overnight accommodation

Bench Fees**Basic* 1 (MFA co-applicants)**

\$1.13/day	principal investigator/graduate student/lab coordinator
\$0.56/day	assistant

Special Requirements 1 (MFA co-applicants)**

\$2.82/day	principal investigator/graduate student/lab coordinator
\$1.12/day	assistant

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

\$2.82/day	principal investigator/graduate student/lab coordinator
\$1.12/day	assistant

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

\$5.64/day	principal investigator/graduate student/lab coordinator
\$2.82/day	assistant

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

\$5.64/day	principal investigator/graduate student/lab coordinator
\$2.82/day	assistant

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

\$11.28/day	principal investigator/graduate student/lab coordinator
\$5.64/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.

Electronic Equipment Charges

Local Area Network Connection

Research Use: \$22/mo for each computer connected to the network

Internet Access

Individual Users: \$11.00/mo

GPS/GIS Equipment

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

Boat Rental

\$320/month, \$125/week - includes maintenance from normal use - gas and oil not included

\$72.50/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

\$5.75/person/day facility day use fee - no meals

\$52.00/person/day 24 hr R&B and day use - summer season (April 30 - September 10)

\$13.00/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 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.