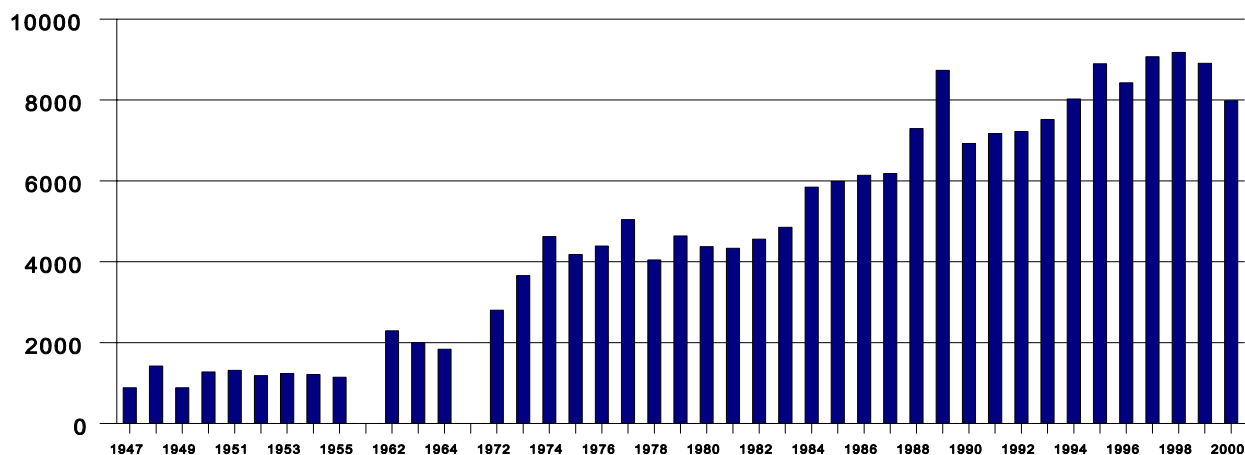


## *Introduction*

2000 was an unusual year at Queen's University Biological Station. Some 7984 user-days in total were logged (user-day data are displayed in tabular form on pp. 63-64). This is down about 10% from 1999. A number of factors conspired to keep levels of use moderate in 2000. The weather was uncooperative, with spring, summer and fall being wet and cool, presenting unfavourable conditions for some avenues of research. Two of our major users (Robertson and Forbes) were gearing down for upcoming sabbaticals. Another major user (Weatherhead) was getting ready to depart for a new position in the U.S.. The net effect of all this was a reduction in the normal level of research use. Despite this, the completion of the new Operations Centre and the activities surrounding a ribbon-cutting and celebration of the new facility made 2000 seem busy.

On average, 37 researchers (professors, graduate students, honours students and assistants) were in residence throughout the summer. Abstracts of 2000 research projects and personnel involved are contained in the following pages (pp. 31 - 58).

## User-Days at QUBS



In teaching activities, QUBS hosted 10 modules (13 weeks worth of modules - three of these modules being two weeks in duration) in the Ontario Universities Program in Field Biology (OUPFB). Six of these modules were presented by Queen's instructors, and four by instructors from other institutions. Titles and enrolments for the OUPFB program are found in Tables 1 and 2 (pp. 25 - 26). In addition to the OUPFB modules, Dr. Ed Kott (Wilfrid Laurier University) brought his field course for senior undergraduates to QUBS for two weeks in late summer.

With the new Operations Centre, QUBS is better able to accommodate field trips of all types. Even the large groups encountered during the prime fall weekends were no problem with the greatly improved facility. The field trips associated with undergraduate courses at Queen's are an vital to the next generation of educators, scientists, fish and wildlife managers and environmental consultants. Exposure to field work is key to sparking life-long interest in biology, ecology or environmental science. Alumni cite their experiences at QUBS as being among the most memorable of their university experience. A summary of conference, meeting and field trip use of QUBS in 2000 appears later in this report (pp. 59 - 60).

## The Operations Centre (Biodiversity Centre)

The highlight of 2000 had to be starting to use the new Operations Centre. The contractor finished his work in March and we took over the building in mid-April. Final finishing and landscaping took up most of the summer and there is yet more to do before we could say that the building is completely finished.

Construction costs on tendering the work came in much higher than expected. Considerable negotiation with the general contractor was then required to keep the overall cost within the funding available yet without sacrificing the overall quality and features of the building. To do this, each and every item was examined and a series of compromises were made to keep the cost within limits. Of necessity, several items were knocked off the contractor's requirements and were left to QUBS. Basically, everything except the septic system and electrical system connections outside the perimeter walls of the building was cut out of the contract. This included the loading bay, landscaping, entryways, water connections, propane connections, walkways, drainage systems and driveways. Dealing with these items kept our staff very busy. At the end of 2000, we still have to address access to the front of the building (at the screened porches), landscaping at the front of the building and down the hill between the Brown Lab and Library, sound dampening for the dining room, a screen door for the kitchen entrance at the loading bay and the lake water connections to the building.

The building is a bright and airy building with so much more to offer than our beloved old lodge. The architect (Tom Blood) and general contractor (Gerry McDonald) have delivered a beautiful building. Throughout, Mike Finn from Physical Plant Services at Queen's helped by coordinating the process. It is expected that the new building will anchor activities at QUBS, allow overall better use of the facilities at QUBS, open up new possibilities for the field station, especially in shoulder season and through the winter, for many years to come.

## Opening of the Biodiversity Centre

In conjunction with the Open House, a celebration to mark the opening of the new building was held on July 9, 2000. To mark this milestone in the history of QUBS, a special occasion was planned by the Department of Development at Queen's in conjunction with QUBS staff.

To provide atmosphere, the musical group Soft Winds played for several hours. They were originally to set up on the lawn under one of the trees, but the weather precluded that (torrential rain persisted throughout the day). Instead, they set up on the screened porch of the operations centre and the music spilled out to the grounds and through the operations centre itself.

Guests were able to tour the displays of the Open House and the Operations Centre itself until 3 pm when they were ushered into the tent (very good planning to have a tent on such a wet day) to the skirl of bagpipes for the opening ceremonies.

Dr. Raleigh Robertson (Professor, Department of Biology at Queen's and Director,

QUBS) served as the Master of Ceremonies. Raleigh welcomes everyone and introduced the platform party: Dr. Robert Silverman (Dean, Faculty of Arts and Science at Queen's), Mr. Peter Milliken (M.P. for Kingston and the Islands), Dr. Peter Boag (Head, Department of Biology at Queen's), Dr. Laurene Ratcliffe (Associate Professor, Department of Biology at Queen's), Dr. James Fullard (Professor, Department of Zoology at Erindale College of University of Toronto), Gillian Glen-Worrall (4<sup>th</sup> year student at Queen's, undertaking an Honours Bachelor of Science in Biology), Dr. Allen Keast (Professor Emeritus, Department of Biology at Queen's) and Dr. David Anderson (Vice-Principal, Operations and Finance at Queen's). Dr. Robertson then went on to introduce visiting dignitaries and distinguished guests, in particular, the Centre's architect, Tom Blood and contractor, Gerry McDonald. He also thanked Soft Winds, the musical group, for their excellent performance.

The following text summarizes the content of the addresses to the group. In the case of Dr. Robertson's remarks, the text is directly from his notes.

Dr. Raleigh Robertson: "The purpose of this ceremony is to mark the official opening of this new Operations Centre of the Queens University Biological Station (the Biodiversity Centre), and to recognize the support that has made it possible.

Just ten months ago, we were still operating out of the old lodge, a seasonal building that served as kitchen, dining room, and to some extent, a centre of operations. However, because of its construction (originally a temporary army mess hall), the old lodge was severely limited in its capacity to serve our needs outside the warm months. During the past twenty years, as the program at the station grew, it became obvious that we needed a new facility with research space, conference room, computer networks, office space and year-round kitchen and dining facilities. This new building provides those facilities.

Much has been accomplished since the old lodge was demolished last September. In order to build a new central facility without disrupting research, we compressed construction into the fall and winter. Thanks to the efficient work of the architect and contractor, the building was finished on time, and within budget! Staying within budget meant some compromises, many of which are related to landscaping and external features such as decks. So, as you can see, many of the finishing touches are still a 'work in progress', a fact that has meant extra demands on our own staff.

Frank Phelan, QUBS Manager and Floyd Connor, Assistant Manager and Rod Green, who has helped with the construction, and is continuing to help at the station, have worked tremendously hard during the past two months, and have made enormous progress to get this centre ready for this moment. I want to recognize their contribution at the outset and let them know how much I appreciate their hard work.

Finally, before I turn over the podium to each of our speakers, I want to comment on what I think has been a remarkable partnership, involving many players. The funding for the centre was made possible by a partnership including private donors and the Federal and Provincial governments. The beneficiaries of this centre, the students, researchers, and the community, are also part of this partnership. We're now going to hear briefly from many of the participants in this outstanding partnership, a partnership that has allowed us to create a new

facility that will provide important support to research and education in conservation biology and a diversity of studies in field biology for decades to come.”

Dr. Robertson then introduced Dr. Robert Silverman, Dean of the Faculty of Arts and Science at Queen’s.

Dr. Robert Silverman

- personal welcome to guests
- recalls the vision for his Faculty that saw the place for an innovation like the ‘wonderful, giant outdoor laboratory’ which is the Queen’s University Biological Station
- briefly highlights the developments over the past few years that have culminated in the new Operations Centre
- highlights the role of philanthropy and voluntarism in making possible these developments
- highlights the particular generosity of Hilda Pangman, through whose funding the ‘Hilda and John Pangman Conservation Reserve’ was initially made possible in 1994, and whose additional recent gift was central to the creation of the Operations Centre
- fundraising for this project began in 1987. Many donations, especially from Queen’s alumni, provided seed money that allowed us to attract major gifts, both from individuals and private foundations, especially those from Mrs. Pangman, Agnes Benedickson, Dr. Allen Keast, the Joseph S. Stauffer Foundation and those, in turn, enabled us to qualify for CGI and ORDCF funds
- references the effective partnership between Queen’s and the government, and expresses thanks for the funding assistance from the Ontario Research and Development Challenge Fund (ORDCF) and the Canada Foundation for Innovation (CFI)
- thanks to the faculty and staff who have worked so hard to bring the vision to reality. In particular, Dr. Robertson, Frank Phelan, Floyd Connor, Dr. Bruce Hutchinson, George Hood, Dr. Gerry Morris and Dr. Peter Boag

Dr. Robertson then introduced Peter Milliken, who was born and raised in Kingston, educated at Queen’s, Oxford and Dalhousie Universities. In 1973 he was called to the Bar of Ontario and enrolled as Solicitor of the Supreme Court of Ontario. Mr. Milliken was partner in a Kingston law firm from 1973 until 1989 before his election to Parliament. He was first elected to the House of Commons in 1988 as the Liberal Member of Parliament for Kingston and the Islands and was reelected in both 1993 and 1997. He currently serves as both Deputy Speaker of the House and Chairman of the Committees of the Whole House. He is also a member of the Board of Internal Economy. In 1997 he was awarded the Padre Lavery Award from the Queen’s University Alumni Association.

Hon. Peter Milliken

- brings greetings from Parliament
- speaks on behalf of CFI and ORDCF

Dr. Robertson then introduced Dr. Peter Boag, Head of the Department of Biology at Queen’s.

Dr. Peter Boag

- thanks the Dean for his kind words
- thanks the architects, Tom Blood Associates of Nepean and the contractor, Gerry McDonald of McDonald Brothers Construction of Ottawa
- acknowledges the support and help on this project given by Dr. David Dennis and Dr. Suzanne Fortier and the work of the original ORDCF/CFI Task Force team, George Hood, Kathy Arney, Sheila Norris and Shelagh Dunn who worked with us on developing the proposal
- thanks Frank Phelan for the concept and development of proposals for the new Operations Centre. Frank, as Manager, has been a very strong proponent of a new, year-round facility
- references the critical role that the station and the Centre play in the Department
- references the exceptional partnership that exists between Queen's and other institutions who also make use of the Centre (specifically names each): Currently, University of Toronto, Carleton University, Wilfrid Laurier University, Brock University, York University, Ithaca College and University of Illinois

Dr. Robertson then introduced Dr. Laurene Ratcliffe, Associate Professor in the Department of Biology at Queen's.

Dr. Laurene Ratcliffe

- speaks of the importance of QUBS and this new building for support of research programs, and hence of graduate training in Queen's Biology

Dr. Robertson then introduced Dr. James Fullard, Professor of Zoology, Erindale College of University of Toronto. Dr. Fullard is one of our principal external users, who is here to represent external users. Also, he is a member of the group that receives an NSERC Major Facilities Access Grant, which is very important to the program at the station.

Dr. James Fullard

- reiterates the usefulness of the Centre to the work of other institutions from the perspective of an external user
- the new building should enhance the station for both external and internal users
- speaks to the need for biologists to have access to good field facilities. Many universities do not have such facilities, so QUBS fills a need for people studying organisms in their natural environment
- thanks to those who made it possible

Dr. Raleigh Robertson: "Before I introduce the final speaker, I want to recognize some special guests who are with us today: Dr. Jan Lifjeld (University of Oslo, Norway), Dr. Tom Hutchinson (Director of Trent University's new field station) and Dr. Ed. Crossman (Curator of Ichthyology at the Royal Ontario Museum, who got his undergraduate training at QUBS in the '40's).

I also want to acknowledge and thank Marg Phelan for her many contributions to both

the setting up of the kitchen and for her volunteer work as station flower gardener.

Finally, I want to thank my wife, Lois, for her support during these past few years of intense fundraising, building design and construction. Lois acts as an important sounding board for me and she has helped me enormously in making decisions throughout the long process of getting this project to the stage of this official opening.”

Dr. Robertson then introduced Gillian Glen-Worrall as student representative. Gillian is a fourth year student taking an Honours Bachelor of Science, Majoring in Biology at Queen's. Gillian is a second-generation QUBS regular. Her mother Liz, now a teacher, was a student at QUBS over 25 years ago.

Gillian Glen-Worrall

- references the good fortune of Queen's students to be able to benefit from this centre
- thanks, on behalf of all students, those who have made this place and the new centre a reality
- speaks to the importance of the station and the new facility for the Queen's graduate program in evolution, ecology, aquatic studies and conservation biology
- emphasizes the importance of the station in graduate and undergraduate training
- speaks to the importance of the new facility for the Queen's undergraduate program in evolution, ecology, aquatic studies and conservation biology
- emphasizes the importance of the station in undergraduate training

Dr. Robertson than calls on Dr. David Anderson (Vice-Principal of Operations and Finance at Queen's), today representing Principal Leggett, Dr. Allen Keast, a long-time researcher and teacher and ardent supporter of QUBS and Gillian Glen-Worrall to ring the bell, signalling the official opening of the new Operations Centre. Old QUBS bell rings.

Dr. Robertson again thanked all for attending and then invited guests to visit the displays of the Open House, continue their explorations and to enjoy refreshments.

The event was a resounding success thanks to the able assistance in planning and execution of Janet Cowperthwaite, Judith Brown, Lili Harriss, Doug Puffer, Mary Johnson and Kelley Moore of the Department of Advancement at Queen's, to the efforts of Julie Lee- Yaw (QUBS Outreach Coordinator) and our QUBS staff, to the cooperation of our Principal Investigators and “Regulars” in preparing displays and interacting with visitors. A special thank you to Mike Harrison who took a series of candid photos throughout the day. Some of Mike's shots are displayed in this report (pp. 27 - 29).

Crabbe Plaque

To commemorate the generosity of Lloyd and Jean Crabbe in the donation of the property adjacent to the Bracken Tract and the house dubbed the “Bird Box”, a plaque was mounted on a field stone beside the entrance to the Crabbe Property.

The plaque reads:

Queen's University  
pays tribute to  
Lloyd and Jean Crabbe

for their generous gift of property  
including the building aptly named  
the Bird Box

On November 14, 2000, Lloyd and Jean Crabbe, Dr. Raleigh Robertson (Director, QUBS), Lili Harris, Judith Brown and Cathy Perkins (Queen's Advancement and Donor Relations) and Frank Phelan (Manager, QUBS), met on site for an unveiling of the plaque. The Crabbes lifted a Queen's tartan from the monument. Lloyd then led a prayer in the circle of friends in which he voiced a hope that their gift would be the beginning of a long-term relationship between the Crabbes and the university and of new and productive uses of the house and property for teaching and research.

After the brief ceremony, the group repaired to the Tea Room in Westport for a quiet luncheon.

#### NSERC MFA Grant

In 2000, QUBS was in year two of three years of an award under the Major Facilities Access Grant (MFA) from NSERC (Natural Sciences and Engineering Research Council). MFA recognizes the value of shared facilities and support of research. With the diversity of users at QUBS and the volume and quality of research at QUBS, NSERC recognizes its contributions to research through this grant. This grant pays the Assistant Manager's (Floyd Connor) salary and benefits and half of a Maintenance Assistant's (Rod Green) salary. The grant may also provide an annual contribution to shared costs of utilities.

QUBS has received this grant (or its precursor, the Infrastructure Grant) for 17 years now. The acknowledgement of excellence of research and training implicit in the award is a feather in the cap of the station. The grant itself permits the hiring of staff which benefits all QUBS users.

#### NSERC Equipment Grant

In 2000, fine tuning of the grant for a "Global positioning system (GPS) and geographic information system (GIS) for Queen's University Biological Station" was accomplished.

#### Wes and Dorletta Curran Scholarship

This scholarship, named for the founding Director of QUBS and his wife, was not awarded in 2000. This scholarship is intended for students in financial need who are carrying out research work at QUBS, with an emphasis on aquatic studies.

#### Pearl E. Williams and Llewellyn Hillis Fund

Established in 1991, this fund was created to "promote the careers and scholarship of women scientists, especially biologists, at all stages of their professional development: and secondly, to promote performances by artists who are women (music, drama, painting). The funds could contribute towards: 1) augmenting the local pool of role models and professional contacts by helping sponsor the visit of established women scientists or artists to campus, including the field station; 2) purchase of a special piece of equipment or attendance at a

conference for which other funds are not available; 3) providing release time from “mothering” or “parenting”. The fund is administered by Dr. Raleigh Robertson.

Two awards were given out in 2000:

Kim Neill (grad student with Dr. John Smol) received \$1200 toward the costs of attending the XIV International Symposium on Chironomidae in Rio de Janeiro, Brazil from 29 August to 2 September 2000.

Jen MacFarlane (senior biology undergrad) received \$500 toward the costs of travel for participating in the Canadian Youth Abroad Everest 2000 Educational Trek.

## History Project

Sporadic progress was made in 2000 in compiling the history of QUBS properties (human, geological and ecological). At the same time, there was some progress made toward assembling a history of the area.

Sue MacLatchie, one of our neighbours on Lake Opinicon, has local heritage as a hobby or, perhaps, an avocation. Sue has agreed to assist us in developing a history of the area. Dr. Smol (Queen's - Biology) and his crew at PEARL (Paleoecological Environmental Assessment and Research Lab) have been working on various lakes in the vicinity of QUBS, including the “Back Lakes” of the Pangman Tract. For their work, an understanding of past history, including perturbations, is vital to understanding the profiles they uncover in their research. Thus, a mutual interest history project was conceived. The group includes those mentioned above, with Celine Muis coerced into coordinating activities of the group. Also involved are Francine Forrest, Kim Neill, John Glew, Tammy Karst and Joanne Little from Smol Labs Inc. and Dr. Euan Reavie (formerly of Smol Labs Inc., now at University of Toronto). Julie Lee-Yaw, our summer staff (Outreach Coordinator) assisted with compiling information gleaned from locals relevant to the project.

In fall, a contact from Dr. Connie Nozzolillo led to some anecdotes and photographs of the early days of QUBS. Connie was at QUBS during the summer of 1947 and had both letters written home and photographs of the buildings and people from that time. Connie is now retired from University of Ottawa, where she was professor of botany. Much of this material was forwarded to Archives for safe-keeping.

## SWEP

In 2000, two positions were made available to QUBS through the Summer Work Experience Program (SWEP). This program is designed “to create on-campus summer jobs for Queen's undergraduate students that will provide them with valuable career-related and/or academic experience.”

Julie Lee-Yaw, a third year student studying education and biology, was hired as Outreach Coordinator (SWEP 169) at QUBS. The position was to develop interpretive information, displays and programs for the public and QUBS users. Display material was to be developed for use in the new Operations Centre and for the web. As to programs, a series of events were to be organized to involve the public in the field station: workshops, tours, seminars, Open House (including Community Newsletter) and opening ceremony for the new Operations Centre. It was a pleasure working with Julie. Her enthusiasm and energy were contagious and she managed to complete much of what was outlined in the job description. Julie's talents in relating to people, her organizational skills and her creativity were apparent in her work. As a



result of her work, QUBS has a good set of display boards in the lower floor of the Operations Centre: building the centre; history of QUBS; local flora and fauna; research and teaching activities. She organized the seminar program, assisted with the Friends of Opinicon outings, drafted up basic web pages, assisted with the opening ceremonies for the new building, produced the Community Newsletter, planned the Open House and myriad other smaller tasks.

Ryan Grant, a third year Geology student with experience in Geographic Information Systems (GIS) and computer operation, was hired as GPS/GIS Mapping Assistant (SWEP 22) at QUBS. Ryan, too, had a busy and diverse summer with duties running the gamut from refining our Ecological Land Classification (definition of map layers), to collecting boundary and point Global Positioning System (GPS) map data in the field for QUBS and for individual projects, to editing the raw GPS files and compiling finished maps, to using GPS to find (and attempt to find) land survey markers, to installing, updating, and configuring computer software. Ryan, working with Julie and with the cooperation of the GIS Lab at Queen's, was able to produce display maps of QUBS properties and surroundings. He also was instrumental in keeping our new local computer network running the way we wanted it to, and did a lot of trouble-shooting and coaching of users.

Our sincere thanks to both Ryan and Julie for jobs well done!

## Seminars

Julie Lee-Yaw (Outreach Coordinator) organized the seminar program for 2000. A full list of speakers and topics appear later in this report (pp. 61 - 62). This year saw a program which combined information exchange among QUBS users and opportunities for outreach by involving the local community through the Friends of Opinicon. These seminars spark a great deal of valuable discussion both among researchers and between the researcher and the interested public. Suggestions for speakers and topics are always welcome.

## Open House

The annual Open House was held on Sunday, July 9 in 2000. Some 375 visitors braved the torrential rain and toured the displays of research. Given the weather, the response was remarkable. The opportunity to tour the new facility and the added interest because of the opening ceremonies kept the numbers up despite the incessant rain. The new operations centre allowed us to bring many displays indoors and carry on with the open house. Without the new building, the event could have been a disaster. To keep things in context, though, this is the first time that it has rained on the Open House in the almost 25 years we have held this event. A great vote of thanks goes to the regulars whose efforts in preparing displays, serving as hosts and communicating with the public make the Open House an event to which people return year after year.

The 2000 version of the Community Newsletter (nineteenth edition) was distributed at the end of June to 1,000 households and cottages in the vicinity of Chaffey's Lock, Elgin and Perth Road Village. The newsletter keeps our friends and neighbours abreast of activities at QUBS, even if they are unable to attend the Open House.

Both of these initiatives are vital to maintaining close contact with the neighbouring community of QUBS, for without support of the community, opportunities at QUBS would become more restrictive.

## The Old Lodge Piano

The fate of the old piano, which had been in the old lodge since forever, had to be decided quickly before the demolition of the old lodge. It was decided to try and find it a new home. Dr. Suzanne Blatt (Queen's Biology) made arrangements to have it moved and repaired. The piano was revived, refinished and retuned - the quality of that 'lady' was such that she was only 'off' by a 1/2 tone. Given the lack of care and the conditions she lived under, it speaks volumes to her quality - she was built in 1890, the 2,468th piano to be built by the Toronto Piano Co. - or so the piano tuner says once he found the serial number. As much as Suzy would have taken her for herself (although John would have killed her), she had another destination - the St. Thomas More Catholic outreach at Queen's and they forked over the \$2000 to have all the work done. She is providing much needed music to accompany their activities. You can see her in Dunning Hall every Sunday at 10 am.

## Renovations and Additions

In 2000, a great deal of effort was expended in details surrounding the new Operations Centre. This R&A section will thus be split into two parts, the first detailing the work required to complete the Operations Centre, the second dealing with improvements to other facilities at QUBS.

### Operations Centre

- 1) Dining Room - We kept the original oak table from the old lodge and had six tables built in oak and stained to resemble the original. The fellows at Timberlakes Furniture accomplished this nicely. These new tables can be expanded or contracted to match seating to the number of users. We also purchased 20 new chairs from Timberlakes to expand our seating for dining to 70. The new chairs approximate the look and stain of the original chairs.
- 2) Glass Porch - The oak armchairs which were the original furniture on the old lodge porch had been moved into storage over time as they needed recovering or repair. For the new glassed porch, these were refinished and upholstered by The Upholstery Shoppe in Westport. The six chairs and two loveseats provide comfortable and inviting seating in the sunny space in the front of the new building.  
Screened Porches - Cedar armchairs and tables were purchased for the two screened porches at the front of the new building. Ten chairs and two tables were purchased from Renewable Energy of Plum Hollow.
- 3) Loading Bay - For foodstuff delivery, a loading bay was designed and built at the rear of the new building. The bay allows the large delivery trucks to back up and offload foodstuffs directly into the kitchen. The loading bay is simple in construction - a box filled with gravel, topped with decking and handrails and steps from ground level to loading level and kitchen. The work was done and nicely finished by Emmon's Contracting from Elgin.
- 4) Tom Blood and Brad Johnson had prepared a guide for landscaping around the Operations Centre. QUBS staff had merely to carry out the work. First, a circular drive was created, leaving the old apple tree in the central oval. A berm was installed in front of the White House, providing a visual screen and separation between buildings. A courtyard was created between the lower entry to the new building and the upper level of the Brown Lab. Walkways were also created joining the front entryway with the circular drive and the grounds in front of the building and to connect the rear entryway of the building with steps to the laboratory level, the White

House and the Library. To do all of this, large rock was used to build retaining walls which were then backfilled with earth. The perimeter of the berm in front of the White House and the oval in the circular drive was planted with daylilies. Shrubs were planted atop the berm. Buckwheat was sown to provide initial cover. Walkways and the courtyard were graded and covered with stone dust. A great deal of effort went into this work, especially the rock walls and fill. There is still much more to do to put the finishing touches on plantings. We have not yet addressed the area directly in front of the porches and connecting with the library and hillside between the Brown Lab and Library, although the old volleyball court was covered with earth and seeded down to lawn. With the new porches, this location for volleyball will not work - alternate suggestions?.

5) Flower Beds - Beside the main entryway to the new building and protecting the large Red Pine tree (which used to hug the chimney on the old lodge), a raised flower bed was created using rock walls and earth fill. This area and the beds created against the building and flanking the main entryway and path to the open area in front of the building were planted with a mix of perennials, ferns and local plants, many donated by our neighbours.

6) The unusual rains of 2000 forced us to provide drainage along the west side of the building. The large area of roof deposited huge amounts of water against the foundation walls and caused considerable erosion and mud deposits early in the year. A system of catchbasins ( two large concrete catchbasins were situated to capture the water descending from the roof valleys flanking the main entrance) and drainage tiles was developed to divert the water from the roof into the drainage system and across the road to the west or across the driveway in front of the loading bay and into the back of the berm by the White House. By midsummer, the system had been well tested and performed as expected. Now, all that remains is to see how the system fares during winter and subsequent thaw.

7) The old bell was preserved and relocated outside the new building to serve its ages-old purpose of signalling meals and warning of emergencies. A new support was built from cedar, modelled after the traditional support. The bell is one of the last sand-cast bells made by the Kingston Foundry. Wes Curran (QUBS founding Director) found the bell in the old Theological College at Queen's where the Biology Department shared space in the early years. He purloined the bell and it has been in place at QUBS since its inception. It is significant that this old bell signalled the opening of the new building during the Opening Ceremonies in summer.

8) At the main entryway, an entrance patio was built to provide the transition between the driveway and the entrance foyer of the new building. Old Towne pavers were installed to provide a clean, durable surface which complements the building itself.

9) In the entrance foyer and the lower hallways, benches were built for removing outside shoes and boots and coathooks were installed above these to permit the hanging of outside garb. These additions are among those required to make the building fully functional.

10) To connect the courtyard between the lower level of the new building and the upper level of the Brown lab, the wooden walkway to the conference room of the Brown Lab was removed and replaced with a an improved one made of cedar. A new wooden walkway was also built to the door to the dry lab of the Brown Lab and the stairs leading to the lower level. These new walkways look terrific and perform well, greatly improving connectivity between the buildings. To do the work, concrete abutments were poured on the side of the scarp between the buildings. Rock retaining walls, graded walkways and steel tube safety railings completed the courtyard work.

11) Cast-iron and hardwood benches were added to the courtyard and the open area in front of the new building to provide outside seating for users.

12) With the assistance of Julie Lee-Yaw, a series of display boards were set up in the lower floor of the Operations Centre. The displays highlight the history of QUBS and its surroundings, show the location of QUBS and its properties, feature the local flora and fauna and depict the scope of activities at QUBS.

13) In the lower conference room, the walls were hung with several items of note. Turid Forsyth's painting was hung in a prominent place. This painting was done by Turid for QUBS and depicts a typical local landscape/lakescape replete with some local flora and fauna. Marg Phelan's painting of the old lodge was also hung in the conference room. Both of these paintings may be used in fundraising efforts at QUBS. Two other frames were hung in the conference room, both gifts from George and Margaret Bracken, one an aerial photo of the Bracken Tract, the other a historical survey sketch of the same property.

For the rest of the building, a few frames and some posters were put up to add some colour to the building. Considerable thought and effort will have to be spent to add some interest beyond the architecture itself. We are currently working with Michael Runtz, a very good photographer and naturalist for a few of his nature photos to adorn the walls.

In the servery, a dugout canoe is displayed above the east serving counter. This canoe is on loan from the Lockmaster's Museum at Chaffey's Lock. Frank offered to keep it at QUBS rather than have it be locked away in storage and out of public view. The dugout was built locally and was donated to the museum. It is an interesting artifact and looks great in the new building. We shall have to get the flowery agreement of loan framed for display as well.

14) Conference room furniture was chosen which allows comfortable seating and myriad ways of setting up the room. Fifty stackable upholstered chairs and twelve small desk/tables were purchased to complement the large Boardroom table obtained from surplus stores at Queen's. In addition, the conference room has been equipped with quality audio/visual equipment and a whiteboard.

15) To complete the furniture requirements of the new building, a map rack, office desks and chairs were purchased (some obtained from Queen's surplus stores) to outfit the administrative offices, the GIS/GPS lab, the instrument room and the office area of the kitchen. File cabinets and shelving have been installed in some of the office space to facilitate effective use of these areas.

16) As part of the overall concept of the new building as an operations centre, a local area computer network was installed. Full details of this network are found in a separate section of this report. This network links all of the computers on site through a gateway computer to the main computer facility at Queen's. Hubs have been provided throughout the new building and to the Brown Lab and Curran Library. A further link to the Trilab is planned, but has not yet been installed. Over time, this will facilitate on-site and distance electronic communications, both for teaching purposes and for research.

17) Utility shelving was installed in the storeroom under the entrance foyer and in the laundry room. The large storeroom provides ample space for sundries and cleaning supplies.

18) Shortly after moving into the new building, it was discovered that there was insufficient passive air circulation in the lower level, resulting in moisture buildup and growth of mold. For the most part, this was remedied by using the furnace blowers to keep air moving at all times. In the case of the storeroom under the glass porch, however, through-the-wall grilles were installed to permit air flow. In addition, a ducted fan working off a timer was installed to force air into and out of this room to reduce humidity and prevent growth of mold.

19) A recurrent odour of sewer gas in the women's washroom was finally tracked down to a faulty toilet floor flange which made an imperfect seal.

20) In fall, a woodstove was installed by LCM Fireplaces in the dining room. This stove has become a focal point of the room and allows supplementary heat from wood to be added to the building as required.

21) To fully complete the operations centre, the lake water system, which will provide lake water to toilets and showers needs to be installed. The compressors for the walk-in freezer and refrigerator in the kitchen are to be removed from atop the units and placed outside. This will reduce both noise and heat problems in the kitchen. Paddle fans will be installed in both the kitchen and front foyer to more effectively move air around (the one in the kitchen is in place, but needs connection to electrical power). A major project will be a front deck and/or patio at the front porches of the new building. This must be both attractive and functional, permitting access to the porches, providing outside activity areas and enabling easy transition from roadway to front lawn to the side hill between the Brown Lab and Library.

22) With the removal of the garbage shed before construction of the operations centre, a new trash system was put in place. A platform was built south of the workshop and two large rolling fibreglass receptacles were installed. This system permits rolling the containers directly onto the large utility trailer without unloading the contents.

#### Other Renovations and Alterations

23) Carpenter ants had been attacking Cabin 3, so the interior panelling was removed, the culprits uncovered, exterminated and damage to the structure repaired.

24) To keep the S15 pickup (small, red) together, some much-needed body work was done in summer. Rear wheel well skins were installed, all holed patched and a paintbrush paint job was done.

25) With the assistance and cooperation Dave Hughson, the rotted ends of the beams and a portion of the floor on the north side of the Horse Barn was replaced in summer. Water and snow runoff is trapped against this side of the structure and has caused ongoing problems. Laminated beams were created to replace the old rotted ones, were treated with preservative and were cemented in place. Hopefully, this will enable further use of the lower level of the barn for effective storage (this work was done in Leggett's storage section of the barn).

26) The wet spring and summer caused water infiltration into the Trilab, especially into Rooms 1 and 4. A trench was dug around the perimeter of the building and drainage tile was bedded into clean stone. The drain tile was sloped toward the lake and diverts water around the building's east side and over the slope by the barge slip. Even during heavy rains, the installation seemed to do its job effectively.

27) In the White House, the taps and shower heads were replaced in a continuing effort to reduce water use. These units get a lot of use. Correcting the leaks and installing water-saver heads should help save water. In doing the work, shutoffs were installed on all lines to simplify work like this in the future.

28) Considerable attention was paid to the road into the station this year. Rock outcrops which occur within the roadway were jackhammered away. The ditching along the major hills was improved to aid in water runoff. All culverts were checked and cleaned out as necessary. The culvert under the Curtis driveway was replaced and buried more deeply to improve its functioning. Gravel was applied to eroded areas and packed before a surface of crushed limestone was added to the entire road - gate through circular driveway and up to loading bay. The course of the road to the boathouse was altered to make it appear as less of a throughway as it joins the new circular driveway. Stone dust was added and the regrowth of a central median

was encouraged for the section that passes the operations centre.

29) The "Rappinicon", our large floating classroom was given a once-over before launch this year. The lower halves of the pontoons (under water) were ground down to bare metal and primed with a quality underwater primer. This time, rather than add a topcoat which does not stay on well anyway, the brass colour of the primer was left visible. Regretfully, in late summer, the inboard engine overheated again (three times in ten years!). Clearly, the propulsion system is too complicated for most users and far too unreliable and will be changed to an outboard which will be much simpler to operate, to maintain and winterize.

30) At the same time that the plaque at the Crabbe property was mounted on a field stone, the gate posts at the entrance were rebuilt using pressure-treated cribs filled with stone. The tube gate was attached to the left post. This improvement both improves access and allows greater security by enabling a properly functioning gate.

31) Another attempt was made to address the leaking roof above Trilab Room 4. Roofing tar/sealer was applied to the entire slope. This effort seems to have stopped the infiltration for now.

### A Local Area Network (LAN) for QUBS

As E-mail and Internet access became a larger and more integral part of users' lives at QUBS over the past years, queues for the one or two modem-equipped computers increased rapidly and so did the annual cost of online time. By spring of this year, it was apparent that we needed to find a creative solution to these problems.

In conversation with Alvin Wood and Bob Robertson of Queen's Networks, it began to look like a local network at QUBS connected by a dedicated line to Queen's in Kingston would solve both of these problems in an affordable way. Alvin and Bob came to QUBS for a reconnaissance session in early June, and by late June we had our new system up and running!

The system installed is a small, peer-to-peer Local Area Network (LAN) (also known as an "intranet"). It ties us directly to Queen's (Kingston) intranet through a small HP gateway computer (with Pentium processor), a 56K US Robotics modem, and a dedicated phone line. It does this using Microsoft Networking shared LAN access, connecting us to the Internet Service Provider (ISP) in Dupuis Hall. It provides E-mail and Internet access for all of the computers within the QUBS LAN, as well as providing shared access to computer files and peripherals.

The LAN at QUBS is simple but versatile, and offers plenty of capacity well beyond our current suite of computers and peripherals. The operational centre is an Allied Telesyn International "CentreCOM FS722" switch plus a "QCBIX 1A" bix in the Mechanical Room of the new Operations Centre. Category 5 wire connects this distribution centre to the manager's office, the director's office, the conference room, the technical lab, the kitchen, and the hall near the main entryway in the Operations centre. In addition, Cat 5 wire has been run in conduit to the Upper Library and to the Upper Brown Lab, and will be run to the TriLab as soon as conditions permit in spring of 2001. In the summer just past, 24-port ATI "CentreCOM" hubs were connected to the Cat 5 wire in the Upper Brown Lab, Upper Library, and the Conference Room and Director's Office of the Operations Centre. At each hub, one port is used for input, and computers (each with its own ethernet card) or other hubs can be connected to the 23 output ports; 3 hubs can be used in any one cascading series beyond the central "switch", giving the potential for an IMMENSE number of total devices in the LAN. This year, the Upper Brown Lab hub was connected to two computers and to a hub in the Lower Brown Lab; it in turn was used by several computers. It is expected that hubs in the Upper Library and TriLab will be used

in a similar fashion, probably extending to a hub in the Upper Boathouse. Individual computers were connected to the Cat 5 wires in the Manager's Office and the GIS lab. Also part of the LAN are our reliable old HP LaserJet III printer and our newer Epson Stylus Color 1520 printer and Epson Expression 836XL Scanner.

After a bit of configuring and occasional troubleshooting by Ryan Grant, the network proved to be versatile, user-friendly, and reliable. Ryan set things up so that email from any of the computers in the system would be filed on the "Coyote" computer to which the LaserJet III is connected, thus making file and space management easier. Suddenly, E-mail and Internet queues disappeared and waiting time and excessive online costs were no longer an issue. Many new smiles appeared on the faces of QUBS regulars! There is even a rumour that some sort of monument (perhaps statues?) is being considered to honour Alvin and Bob!

### Field Safety

Queen's University has developed a comprehensive field research safety policy and well as guidelines for safety in field research. QUBS users are expected will be expected to fully adhere to the principles and guidelines established. The field policy documents are available on the Queen's website at <http://www.safety.queensu.ca/safety/policy/fieldpol.htm>

In early summer, Weibe Wilkens, Director of Environmental Health and Safety was invited out to QUBS to participate in a field safety workshop for QUBS users. On May 15, Ms. Wilkens introduced the university policy to the QUBS group and Frank Phelan led a discussion on specific safety issues at QUBS. The workshop was well-attended and very worthwhile and kept safety issues at the fore for the summer.

### Watercraft Safety

It will soon be necessary for motorboat operators to have proof of proficiency. This proof is supplied after successfully completing a safe boating course or passing a test on safety, regulations and rules of the road. To ensure that QUBS users have a basic understanding of these issues, a familiarization exercise and test was devised by QUBS staff for all outboard motorboat users. This procedure is merely an interim measure - soon, QUBS boat operators will have to comply with the impending legislation (all operators of power watercraft under 4 m in length will require proof of competency by September 15, 2002).

### All-terrain Vehicle Safety

Recognizing the need for operator competency in boats, it was realized that operators of ATVs should also be competent. Therefore, a familiarization with use of ATV and a test of operator competency was devised before anyone was able to use the station ATV. In addition, safety helmets were purchased and provided to users. For 2001, the training manual used by 4-H Clubs will be used as a basic handbook for ATV safety training.

### Naturalist Workshop

In 2000, as in 1998 and 1999, no Naturalist Workshop activities were undertaken. It was decided not to offer a Naturalist Workshop program to avoid competing with lodge replacement

and construction of the new Operations Centre. It is expected that this outreach program will be back on track for 2001. As of this writing, several mid-summer workshops are being discussed. Details will be available on the QUBS website.

### Friends of Opinicon

The summer of 2000 was full of events for the QUBS Friends of Opinicon. Weekly seminars were given on Monday evenings in July and August by academics from various institutions. These talks, including special presentations by local artist Turid Forsyth and Algonquin Park naturalist, Michael Runtz, drew large audiences, making good use of the new conference room in the Biodiversity Centre. All talks were followed by wine and cheese social gatherings which allowed people the opportunity to ask the speakers questions, meet new friends and sample a tasty assortment of local cheese!

The station also lead a series of interpretive walks on Thursday evenings. Several trails on and around station property were explored, introducing walkers to the flora and fauna of the area and promoting an appreciation for the diversity of life around us.

To wrap up a busy season, the Friends held a pot luck dinner hosted by Nas MacDonald. Major social events such as this give us an opportunity to get some feedback from the Friends members. This year several members commented that they found the programs to be both enjoyable and informative.

### Station User Fees

The fee schedule for 2001 appears on the last pages of this report (pp. 65 - 66). Fees for board have been increased by about 10% in an effort to keep pace with the increasing costs of food, utilities and salaries. Fees for accommodation have increased substantially. With increased costs of maintenance and utilities, we have been falling behind in cost-recovery for accommodation. Also, comparison of charges for accommodation at QUBS with other field stations have shown that QUBS fees for accommodation have been very low. The current fee schedule will still have QUBS on the low end of charges, but the changes should improve our level of cost-recovery and enable better maintenance of our accommodations.

For 2001, a multi-tiered system of bench fees has been established. This system is designed to recognize the contributions from Queen's on behalf of Queen's users and from NSERC MFA on behalf of co-applicants of the MFA grant and to better match the fees charged to the levels of use of services and facilities by various users.

These fee schedule changes are necessitated by a tight fiscal policy at universities and a progressive shift to effective cost-recovery wherever possible at QUBS.

### Theses and Publications

A list of publications and theses is maintained at QUBS to document uses of QUBS over time. This compendium is important as a reference database for QUBS users. In an attempt to keep our listing of these and publications emanating from work carried out at QUBS as current as possible, please submit citations as soon as available. In addition, copies of theses should be forwarded to QUBS for the library (we will have them bound as necessary). Reprints of publications would be appreciated. As soon as practicable, it is intended to post the thesis list and publications list for QUBS on the website.



## Parks Canada- Rideau Canal

Doug Stewart (Superintendent of the Rideau Canal), on behalf of Parks Canada - Rideau Canal, has provided QUBS with complimentary passes for both of our pontoon boats (floating classrooms) for 2000, continuing a pattern of generosity going back many years. Mr. Stewart and Parks Canada are to be thanked for this generosity. These passes facilitate access to many study lakes along the Rideau Canal and provide a wide range of research and teaching opportunities at no cost to QUBS personnel. In 2000, access to Sand, Indian, Clear, Benson and Newboro Lakes permitted a variety of interlake comparisons.

## Acknowledgements

Thank you to Floyd Connor (Assistant Manager), Roger (Rod) Green (Maintenance Assistant), Cheryl MacDonald, Terri Castle, Lucinda (Cindy Lou) Chrissley, Marg Phelan, Cathy Lee Chrissley and Robert Vinkle (Food Service Staff) and Hynek Holka (landscaping assistant) for their efforts on behalf of QUBS. It is the contribution of all of our staff, no matter in what capacity, that contributes to the overall success of the field station.

## Staff Training

In fall, all of our kitchen staff (Marg, Cheryl, Terri and Cindy) took a food safety/food handling course at the Kingston Frontenac Lennox and Addington Health Unit. The training received should assist them in their positions in foodservice at QUBS.

## Cover

The front and rear covers are from photographs taken by Adrian Searle for our Architect (Tom Blood) of the new Operations Centre in late summer.

## **Global Positioning System (GPS) and Geographic Information System (GIS)**

As anticipated, GPS and GIS at QUBS are rapidly increasing both in the number of studies using them and in their importance in individual studies. Most researchers are now aware of the availability of these capabilities at QUBS, and many are incorporating them into the design of their studies from the very beginning. This becomes even more attractive to them as our capabilities in these areas improve, and as our data base expands and diversifies.

Our GPS equipment in 2000 includes a Trimble TSC1 datalogger connected to a ProXRS satellite and RTCM receiver, two GeoExplorer II small GPS hand units, and our reliable old two-antenna backpack unit with an MC-V datalogger and ProXL and ProBeacon antennae and receivers. In March, we upgraded the datalogging software on the TSC1 to Asset Surveyor 5.0; the MC-V has reached its "ceiling" as far as upgrades of software, for the Asset Surveyor 3.16 that it now uses is the last that will be written for it. Later in the summer, we had a couple of problems with electrical cables and bought a new data cable for the TSC1 and two new external battery cables for the GeoExplorers.

GPS users at QUBS have relied exclusively on real-time differential correction (RTCM)

of incoming data, rather than performing in-lab post-processing with base station data. This has been both a time-saver (especially important when using shared equipment) and a convenience (we have had no need to access base station files from other facilities). It has also been key to our ability to navigate to points whose co-ordinates were known but which were in otherwise untracked forest. The need for differential correction of any kind was greatly reduced beginning on 1 May 2000 when President Clinton announced the removal of Selective Availability, the error factor which until that time the U.S. Department of Defense had programmed into the GPS satellite signals. For us, this means that even the GeoExplorers (which don't have RTCM receivers) can be used to collect quite precise data without post-processing, although their antennae limit their precision to within 2 to 5 meters as opposed to the sub-meter precision of the better antennae of the TSC1 and MC-V assemblies. These latter also continue to gain some refinements from their RTCM signals.

GPS equipment was, as stated, used both extensively and intensively in the summer of 2000 to collect spatial data both for general QUBS use and for individual studies.

Ryan Grant, as our "Mapping Habitats Assistant" funded by the SWEP program at Queen's, re-examined our Ecological Land Classification (ELC) system, and did some fine-tuning of the categories into which we were slotting our mapped habitats. The result is a simpler and more understandable layer system for our maps. He then did considerable mapping of habitats, both for QUBS and for some of the individual research projects. Considerable effort was spent in attempting to determine UTM co-ordinates for survey markers as shown on survey plans for QUBS properties, and then in attempting to navigate to these markers and locate them in the field using GPS. Ryan and Floyd frequently worked together on this part of the summer's activities. Ryan also assisted with GPS data collection for projects such as the Least Flycatcher projects, where a lot of data were needed in a hurry and maps were required in very short order.

Many researchers collected GPS data for their own research, using the QUBS equipment. The Black Rat Snake team headed by Gabriel Blouin-Demers has been using this equipment since 1996, and continued to use it extensively this summer. Co-ordinates of snakes' positions are used to calculate distances moved, home ranges, etc. Scott Tarof, in his study of Least Flycatchers, was very appreciative of the availability and quality of our GPS equipment. He writes:

"The GPS field equipment has been an instrumental component to my research on least flycatchers. Were it not for this equipment, I would not have been able to map clusters with nearly the same accuracy. However, the benefits of GPS data go far beyond the maps themselves. That is, by using PFinder I am able to quickly gather distance and territory size data. I think the sign-up process worked well this past summer. It was always clear when the equipment was available. The organizational setup of the equipment itself was also well-organized and user-friendly. Personally, I don't see a need for upgrades at this time. The equipment certainly meets my needs. Indeed, I would argue that QUBS is among the best-equipped GPS/GIS facilities around!"

Similarly, Dan Mennill is enthusiastic about the contribution of our GPS and GIS facilities to his research on Black-Capped Chickadees. He writes:

"In 2000, I used the global positioning system at the Biology Station to monitor nest site selection, territory boundaries, and female movements. Due to an early spring, most breeding pairs of chickadees

excavated many different nest cavities. We mapped all excavations, and comparison of these nest sites will be a revealing analysis of how chickadees choose their nest locations. In conjunction with radio-telemetry, we used the global positioning system to reveal patterns of female movements in the early mornings during the breeding season. We also completed a detailed map of the area from Cold Spring Swamp to the outskirts of Chaffeys Locks (West to East) and from the rail line to the tip of the Station Point (North to South), including an extensively gridded area on the Curtis property. The global positioning system at QUBS, in conjunction with the GIS software and the powerful new computer, is a vital part of our research."

Our GPS and GIS systems were extensively used by the Cerulean Warbler teams to map nests and territories, and eventually to perform a variety of analyses on these data. To greater or lesser degrees, these systems were also used by those studying Columbine, Deer Flies, and Large-Mouth Bass. One novel use of the GeoExplorers this season was to map the movements of Large-Mouth Bass which had radio transmitters implanted in them and could be tracked using a directional antenna, similar to the procedures used by the Black Rat Snake crew.

Our Dell Precision 410 Workstation computer remains at the centre of our data processing and analysis for GPS and GIS. With attached Epson Expression 836XL flatbed scanner and Epson Stylus 1520 Color printer, it continues to serve those needs well. In early summer we encountered a drive problem, and after some sleuthing and formatting by Ryan Grant and our computer whiz neighbour Stan Johnston we got it back in action and at the same time replaced the Windows NT operating system with Windows 2000. Ryan then obtained and installed patches for several of our programs that had originally been designed to operate in an NT or Windows 98 environment. We also installed System Suite 3.0 by Ontrack, which greatly facilitates drive maintenance and troubleshooting on this computer.

Ryan put a lot of effort and thought into the GIS at QUBS, both for the summer of 2000 and for the future. In response to a request for his views on the subject, he writes:

"I think that at the end of last summer, the GIS has reached a stage at which it is ready to start becoming a real GIS. ie useful for more than just maps. With all of the old data cleaned up, and the new layering system in place, it is ready to have more features added, and to be combined with a database. With the help of ArcInfo, I think that the GIS can become an extremely useful product, when the right information is collected. As it stands, if all of the QUBS properties were completely GPS'd at the layer level that it is currently running at, the main use will be for "maps" and maybe to help with the habitat analysis of researchers. I believe that the GIS could possibly reach a level that would become infinitely more useful. In order to do this, a more detailed survey would need to be conducted, and a much finer scale. This survey would consist of a surficial geology layer with a high emphasis on soil acidity and such, combined with a more detailed vegetation plot. This would involve taking the ELC to the next scale level. An example of this would be breaking the "Deciduous Forest" layer into the 20 or so smaller layers such as "Dry Fresh Oak Forest Ecosite". At this level, the researchers would not have to do "veg plots" (unless they need to map individual trees), and could do some detailed habitat analysis. Of course, collecting all of this is a giant amount of work, and the aid of up-to-date radar imagery would be useful, as analysis can be done from the computer. In addition,

this would provide a nice backdrop for the maps.”

As this report is being written, Ryan continues to work on user-friendly “Help” files for using GPS and GIS at QUBS. In addition, by the time this Annual Report goes to press, we fully expect to have the full and up-to-date versions of both ArcView and ArcInfo installed on our GIS computer here. So the system continues to grow and evolve, we hope to the benefit and satisfaction of our users.

## QUBS Properties

For records-keeping purposes, this section of the Annual Report will list uses of properties, management activities and changes pertinent to specific areas. Entries will be made corresponding to particular tracts of land.

### **GIS Mapping**

Work continues on the development of a Geographic Information System for QUBS. Data collected using Global Positioning System equipment are continually being added to the database. Mapping of physical features of QUBS properties ( trails, roads, shorelines, habitat margins and conspicuous features) continues. With the help of Ryan Grant, properties were mapped using an Ecological Land Classification system.

There continues to be difficulty in reconciling survey and metes and bounds descriptions of properties with on-site GPS data. Hopefully, this can be eventually resolved, so as to provide the best location information possible to QUBS users.

Over time, a fully functional GIS will develop. This database will enable an overall management plan for QUBS properties.

### **Hughson Tract**

The Hughson Tract was used for studies of Tree Swallows, Eastern Bluebirds, Least Flycatchers, Golden-winged Warblers, damselflies, dragonflies, moths, butterflies, water mites, Columbine, Ragweed, secondary succession, land management, Black Rat Snakes, Northern Water Snakes, frogs, Pumpkinseed Sunfish and the possible effects of bismuth on vegetation in 2000.

Dr. Weatherhead and his students continue to use the snake pens constructed at the back of the S.R. Brown fields, just at the east side of Lindsay Lake Pond.

The various bird box grids were used intensively by Dr. Raleigh Robertson and his students in work on cavity-nesting birds (Tree Swallows and Eastern Bluebirds).

The New Barn field plots used by Dr. Aarsen and his students were plowed and roto-tilled in fall. Rotation plots in the Lane Sargent Field were plowed by David Hughson in early November. These will still require roto-tilling in spring as conditions permit.

Haying of the open fields was done by Bob Butterill and David Hughson. David has been using the Horse Barn to store some of this hay.

In cooperation with David Hughson, repairs were made to ends of beams and floor in this barn.

### **Bonwill Tract**

In 2000, The Bonwill Tract was used for studies of Cerulean Warblers, Golden-winged Warblers, Least Flycatchers, damselflies, dragonflies, water mites, moths, butterflies, frogs and Black Rat Snakes. In addition, the Canadian Wildlife Service Forest Bird Monitoring Plots were visited by Floyd Connor and Dr. Allen Keast, and the Ontario Ministry of Natural Resources (Eric Boysen - Kemptville) maintains several Growth and Yield Plots flanking the Bedford Road.

Jim Barton did some trail management to keep the walking trails open.

Haying of the open fields was done by Bob Butterill.

### **John M. Cape-Charles Sauriol Environmental Studies Area**

The Cape-Sauriol Tract was used for studies of dragonflies, damselflies, water mites,

deerflies, horseflies, waterstriders, Columbine, Largemouth Bass, sunfish, frogs, Black Rat Snakes and paleolimnology in 2000.

### **Hilda and John B. Pangman Conservation Reserve**

In 2000, the Pangman Reserve was used for studies of Cerulean Warblers, Golden-winged Warblers, Eastern Bluebirds, Least Flycatchers, Columbine, Black Rat Snakes, dragonflies, damselflies, water mites, moths, butterflies, frogs, Largemouth Bass, Northern Pike, fish communities and paleolimnology (especially lake histories from diatoms and fossil Chironomids).

Warner Lake and Long Lake are used for study on Largemouth Bass populations. Frank Phelan, Dr. David Philipp and students have individually PIT-tagged most of the male bass in the lakes and are conducting a multi-year study of bass populations. The lakes have been posted as research lakes and closed to fishing. In Lindsay Lake, a similar study has been started on Northern Pike. A new road to the back of Warner Lake was marked out and opened up in early summer. Using this road precludes having to disturb Jeff Ashby and Carla Lewis who own Wayne Hughson's old house. This road veers off the Lindsay Lake Road at the back of the plantation field and runs west to a landing at the side of Warner Lake.

The outpost cabin on Long Lake greatly facilitates lake work. QUBS has added boats on Lindsay and Round Lakes in the Pangman Reserve to improve research access.

The suite of small lakes (especially Round Lake) is also of great interest to paleolimnologists documenting climate change and forest structure changes in the past. Researchers involved in studies there include members of the John P. Smol lab at Queen's.

In summer, a work party cleared the roadways and trails to maintain easy access.

The Lindsay Lake Road continues to be a popular place for nature walks with various groups.

### **Bracken Tract**

The Bracken Tract was used for studies of Tree Swallows and Eastern Bluebirds in 2000.

In fall, the property was intensively used by students in Geology 221 (Geological Field Methods). Doug Archibald had the students determine the stratigraphy of the surficial sediments with soil augers and conduct a magnetometer survey to determine the contact zone between the background gneiss and the magnetic gabbro which holds the magnetite. This work is of interest since the area used to be home to a very successful iron (magnetite) mine.

Maurice Hutchings is permitted to graze cattle on this tract. In exchange, Maurice keeps an eye on the property.

### **Moore's Tract**

In 2000, the Moore's Tract was used in studies of Black-capped Chickadees, moths, butterflies and water mites.

In spring, Frank and Floyd met Dr. Gerry Wyatt and Mary Ev, who own the property immediately to the west of the Moore's tract, and remarked the walking trail through the property, along the ridgetops from the Wyatt property to the Indian lake Road. Reopening this trail would improve access to the interior of the property.

### **The Weather Report**

As described in the 1999 Annual Report, in December of that year the QUBS "21X" micrologger was sent to Campbell Scientific (Canada) in Edmonton for maintenance and updating. It was reinstalled at QUBS and began collecting data on 20 January 2000. Over the

ensuing days, the operating program was revised a couple of times. By 24 January 2000, the current version of the micrologger operating program ("QUBS2000.CSI") was installed and has operated smoothly ever since.

The current system is very similar to the one operated for the last several years. The same sensors (3 water temperature probes, air temperature and relative humidity, soil temperature, wind speed and direction, sky and solar radiation, and rainfall) are scanned every 5 seconds and summaries of the values are stored at a variety of intervals. The current program expands the scope of the hourly summaries, leaves the daily summaries approximately the same, and has expanded (but optional) 5-minute and 10-minute summaries. Anyone interested in data for these shorter time intervals should contact Floyd *before the beginning* of the season of interest, for these functions will not otherwise be activated. The 20-minute summaries of the earlier program are not produced by the current version.

January through March of 2000 seemed notably warm and dry, with several periods essentially snow-free. By the end of March, the flow over the spillway at Chaffeys Lock was so reduced that it seemed that one could have walked upstream past the Mill in only "Wellingtons" and still remained dry. The rains began in April and continued in notable abundance through May. Many residents at QUBS have raised questions about the "normalcy" of our current weather. In response to this interest, I have prepared the enclosed comparative summaries, "QUBS Partial Weather Summaries" and "Ice On/Off and Surface Probe Installation Dates".

The "QUBS Partial Weather Summaries" have carefully been prepared by summarizing 5 years of daily summaries, April through October. However, they should be used only to alert users to possible trends and patterns in the variables and should not be cited in publications. There are minor gaps in some variables due to equipment failure and QUBS "winterizing" procedures, and researchers would want to address these in statistically rigorous ways.

Two types of gaps are most notable. The "0.2m" and "1.2m" water temperature probes are normally either pulled up on shore or sunk to the bottom of the lake in winter, to avoid ice damage. Hence, they in fact do not measure temperatures at their nominal depths until properly "installed" after "ice out" in the spring. The water temperature summaries for the 0.2m depth in April and May therefore are derived from a reduced data set, beginning the day after the "Installation Date" as listed in the "Ice On/Off" table. The second type of gap was created by a plugged rain gauge in June and July of 1999; we thank Jenn Barg and Jason Jones for rainfall data from the Bedford Road Cerulean Warbler study sites which were used to supplement the QUBS data.

**Ice ON/OFF and Surface Probe Installation Dates for Lake Opinicon, 1995 through 2000.**

	1995	1996	1997	1998	1999	2000
Ice Off ("Ice Out")	30 Mar	16 Apr	22 Apr	06 Apr	11 Apr	26 Mar
0.2m Temp. Probe Installed	30 Mar	25 Apr	22 Apr	17 Apr	37027	27 Mar
1.2m Temp. Probe Installed	30 Mar	25 Apr	22 Apr	17 Apr	37027	27 Mar
Final "Ice On" (Complete)	24 Nov	24 Dec	30 Nov	23 Dec	19 Dec	08 Dec

QUBS PARTIAL WEATHER SUMMARIES, 1996 THROUGH 2000

		Water Temp 0.2m °C			Water Temp 3.3m °C			Air Temp 1.5m °C			Wind Km/hr		Rain in	Radiation
		avg	max	min	avg	max	min	avg	max	min	avg	max	mm	kW-hr/m <sup>2</sup> /day
APRIL	1996	8.6	9.8	7.7	6.4	9.4	4.5	4.7	18.8	-7.7	10.8	66.6	99.3	3.55
	1997	9.3	13.2	6.0	9.2	11.9	7.1	5.0	19.6	-11.3	9.0	67.7	49.2	4.66
	1998	12.5	15.8	10.1	9.0	14.8	4.2	8.7	22.0	0.0	8.3	59.0	16.8	5.35
	1999	NA	NA	NA	7.5	13.3	3.7	7.5	21.8	-2.5	11.2	53.3	18.1	5.52
	2000	7.2	13.3	4.4	7.0	10.9	4.7	5.8	20.9	-4.9	12.6	50.4	104.9	3.58
MAY	1996	14.4	21.0	8.0	13.4	19.2	8.4	12.6	26.2	0.8	11.2	71.6	68.2	5.83
	1997	15.0	20.0	11.8	12.4	16.6	10.3	10.7	23.9	1.0	11.5	85.0	67.7	4.87
	1998	19.2	23.9	13.3	18.1	23.7	13.4	17.3	30.7	6.1	7.2	75.6	44.1	5.64
	1999	19.3	23.5	16.8	16.9	21.9	11.9	16.3	28.3	4.7	10.8	58.0	30.5	6.28
	2000	15.7	19.2	10.2	15.3	18.3	8.2	13.7	27.0	2.6	12.2	61.2	106.5	4.70
JUNE	1996	21.8	26.7	17.3	20.3	23.3	17.6	19.5	34.0	9.2	9.0	57.2	67.5	5.04
	1997	22.5	27.9	16.8	21.3	26.6	15.4	20.1	31.5	9.6	8.3	59.8	68.6	6.72
	1998	22.3	35.0	17.2	21.4	27.3	17.5	19.0	31.0	7.2	8.6	59.1	109.1	5.45
	1999	23.9	28.1	20.7	23.4	26.5	19.4	20.4	31.6	8.4	11.5	51.5	80.0	6.43
	2000	20.2	25.3	17.0	19.8	23.9	17.1	17.2	26.7	5.7	11.9	61.2	88.8	5.62
JULY	1996	23.5	26.5	21.4	23.0	25.0	21.6	20.7	29.7	12.4	10.4	59.8	75.0	5.83
	1997	24.9	28.2	22.1	24.7	27.1	22.4	21.1	31.6	11.0	9.0	59.8	43.5	6.46
	1998	24.5	27.6	22.3	24.5	27.1	22.6	21.0	30.6	12.2	9.7	68.8	57.4	5.76
	1999	26.2	29.1	23.2	25.9	28.1	23.3	23.0	32.8	12.7	12.2	66.6	140.0	6.50
	2000	23.7	28.0	21.8	23.0	25.9	22.0	19.6	29.1	11.6	7.9	55.4	95.7	5.66
AUGUST	1996	25.0	29.4	22.3	24.2	26.6	22.5	21.6	33.0	11.0	9.0	59.1	63.0	5.45
	1997	23.2	26.4	21.3	23.0	25.1	19.8	19.1	30.7	10.7	6.5	54.0	116.0	5.04
	1998	24.2	26.6	22.8	24.4	26.0	22.8	20.6	30.0	10.1	7.9	61.2	95.3	4.92
	1999	23.7	28.1	21.7	23.4	27.1	21.1	19.5	31.6	10.2	8.6	55.1	33.5	4.80
	2000	24.1	28.0	21.8	23.7	26.0	21.9	19.7	28.6	8.9	10.1	51.1	77.4	5.35
SEPTEMBER	1996	21.0	28.4	15.6	20.6	29.5	16.0	19.1	31.5	6.6	7.9	52.2	139.5	3.31
	1997	19.3	26.2	15.4	19.2	22.8	15.6	15.5	37.1	0.9	8.6	58.7	94.4	3.50
	1998	20.7	24.7	18.1	21.1	24.3	18.4	16.9	29.2	4.9	8.3	59.8	55.1	3.94
	1999	21.2	26.6	16.5	20.8	24.8	16.7	17.7	33.4	6.4	10.4	65.5	109.6	3.72
	2000	20.1	26.7	15.4	20.0	24.1	15.6	15.0	30.5	1.1	11.9	78.5	84.2	4.08
OCTOBER	1996	12.5	18.5	8.8	12.5	17.0	9.1	9.7	22.3	-1.4	11.9	68.8	75.1	2.33
	1997	13.4	19.3	7.7	13.4	16.9	7.7	9.0	25.0	-2.6	7.2	53.3	48.7	2.90
	1998	14.1	18.7	10.5	14.4	19.3	10.7	10.4	21.0	1.9	10.1	66.6	49.1	2.90
	1999	12.7	17.5	9.3	12.8	17.7	9.4	9.0	19.6	-1.6	12.2	56.2	54.4	2.71
	2000	12.9	17.7	9.2	12.9	16.7	9.4	9.5	22.2	-1.7	10.1	51.1	31.8	2.50



**Table 1: Summary of enrolments in the Ontario Universities Program in Field Biology in 2000 (QUBS courses highlighted)**

Course	Instructor	Affiliation	Module	Weeks	Location	B	C	G	M	O	Q	To	Tr	Wa	We	Wi	
1	Barton/McKinley	Waterloo	Tropical Marine Ecology	2	Jamaica	0	0	5	1	0	0	3	1	5	2	0	
2	Robertson	Queen's	Behavioural Ecology-birds	2	QUBS	1	0	0	1	1	4	0	1	0	0	0	
3	Fahrig	Carleton	Ecology of S. Florida	2	Florida	0	1	2	0	0	1	1	1	0	1	0	
4	Freisen	Queen's	Intro to Ornithology	1	QUBS	0	0	0	0	1	4	1	2	0	0	0	
5	Maclsaac/H	Windsor	Great Lakes Field Biol.	2	Great Lakes Inst.	1	0	1	0	0	1	1	0	0	3	2	
6	Middleton	Brock	Ecosystem Disturbance	2	Argentina	0	1	3	0	1	3	0	0	0	0	1	
7	Rising	Toronto	Field Ornithology	2	Huntsman MSC	1	0	1	0	0	1	8	0	0	1	2	
8	Tufts	Queen's	Ecol. Physiology - fish	1	QUBS	0	0	0	0	2	5	1	0	0	0	0	
9	Lougheed	Queen's	Herptile Biodiversity	2	QUBS	0	0	0	1	0	8	3	1	0	1	0	
10	Hutchinson	Trent	Ecology of Kawarthas	2	Peterborough	0	0	0	0	0	1	1	6	0	1	0	
11	Darling	Toronto	Biodiversity - IndoChina	2	Vietnam	0	1	0	0	0	3	5	1	1	1	0	
12	Conlan	Carleton	Marine Invertebrates	2	Huntsman MSC	1	1	1	0	0	1	1	0	0	0	0	
13	Burt	Western	Environmental Science	2	Huntsman MSC	0	0	0	0	0	1	1	0	1	0	0	
14	Hansell	Toronto	Arctic Ecosystems	2	Churchill, Mb	0	1	0	1	0	2	7	0	1	0	0	
17	Schreer	Waterloo	Marine Mammals	2	Huntsman MSC	0	0	4	0	0	4	1	0	2	0	0	
19	Gunderman	McMaster	Insect Taxon./Ecology	1	QUBS	0	1	0	0	0	4	1	0	0	0	0	
20	McQueen	York	Lake Structure/Function	1	QUBS	1	0	0	0	1	3	0	3	0	0	0	
21	Shore	York	Plant Repro. Ecology	1	QUBS	1	0	0	0	0	2	1	0	1	0	0	
22	Hodson/Bl	Queen's/O	Ecotoxicology	2	Cornwall, On	0	0	0	0	2	5	1	2	1	0	0	
23	Millar	Western	Alpine Ecology	2	Kananaskis, Al	0	0	0	1	0	5	0	1	0	1	2	
24	Roots	Toronto	Photography for Ecol.	1	Algonquin Pk	0	0	3	1	3	5	3	1	3	0	0	
25	Birt	Queen's	Biology of Fishes	1	QUBS	1	1	0	0	0	4	0	3	1	0	0	
26	Pringle	McMaster	Systematics - plants	1	QUBS	1	0	1	0	1	4	3	0	0	0	1	
27	Snetsinger	Queen's	Appl. Environ. Ecology	2	QUBS	0	0	0	0	1	7	1	0	1	0	0	
28	Owen	Western	Marine Animals	2	Huntsman MSC	0	0	1	1	0	5	0	0	2	3	0	
29	Owen	Western	Exptl. Marine Biology	2	Huntsman MSC	0	0	0	1	0	2	0	1	1	1	0	
30	Malloch	Toronto	Marine Biology	2	Huntsman MSC	0	0	0	0	0	5	8	1	1	1	0	
31	Ferris	Toronto	Biogeochem. Processes	1	Deep River, On	0	0	0	0	0	0	14	2	1	0	0	
32	Hawthorn	Waterloo	Terr./Aquatic Biology	2	Algonquin Pk	1	0	0	1	1	4	2	0	4	1	1	
33	Kolasa	McMaster	Tropical Ecology	2	Jamaica	0	1	7	6	1	1	2	0	1	6	0	
34	Williams	Toronto	Tropical Marine Biology	1	Barbados	0	0	1	0	0	0	12	0	0	0	0	

#students	9	8	28	15	15	95	82	27	27	23	9	
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#student-weeks	14	14	50	29	22	159	128	43	48	46	17	
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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 2000

	B	C	G	M	O	Q	To	Tr	Wa	We	Wi	Y	Other	Total Student-Weeks	Tot Hal
Total Student-Weeks Not at QUBS	4	12	49	25	13	85	113	31	44	44	16	28	20	484	
Total Student-Weeks at QUBS	10	2	1	4	9	74	15	12	4	3	1	18	0	153	
Total Student-Weeks in Field Modules	14	14	50	29	22	159	128	43	48	46	17	46	20	637	
Total Half-Course Equivalent in Field Modules	7	7	25	14.5	11	79.5	64	21.5	24	23	8.5	23	10		

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

24% of credits in entire program earned at QUBS in 2000  
(13% in 1999; 22% in 1998; 18% in 1997; 25% in 1996; 26% in 1995)

47% of Queen's credits earned at QUBS in 2000  
(26% in 1999; 40% in 1998; 33% in 1997; 45% in 1996; 34% in 1995)

## ***I. Research conducted by Queen's University Personnel in 2000***

***Dr. Lonnie Aarssen***

### **"Plant Ecology and Evolution"**

**Viviane Paquin - "Allometric gender allocation in ragweed (*Ambrosia artemisiifolia* L.)." - M.Sc. Thesis.**

Cultivated field plots in the New Barn field were used for an experimental study involving *Ambrosia artemisiifolia* designed to test hypotheses for allometric gender allocation in plants (size-dependent allocation to male versus female reproductive function). We predicted that variation in size measured as height resulting from variation in neighbour effects (light availability), will generate allometric gender allocation consistent with the pollen dispersal hypothesis, whereas variation in size measured as biomass resulting from variation in soil resources or defoliation intensity, will generate allometric gender allocation consistent with the size advantage hypothesis.

Field and greenhouse experiments were conducted to produce a range of plant sizes in response to a gradient of neighbour effects, light availability, soil resource availability or defoliation intensity. With the exception of the defoliation experiment a wide variation in fecundity and size was observed among the treatments. There was a strong allometric relationship between maleness and increasing plant height when plant size variation was due to variation in neighbour effects. The shading effect of neighbours appears to cause a shift to greater femaleness in shorter plants and greater maleness in taller plants. The frequency of all-female plants increased from 10% to 87% under strong neighbour/shading effects. Allocation to the male function increased faster with increasing height in the neighbour experiment than in the nutrient experiment where there were no neighbour effects on size. This is consistent with previous findings that the promotion of maleness in natural populations of *Ambrosia* depends more on relative plant height within the neighbouring canopy than on absolute plant height. Allocation to the male function increased faster than allocation to the female function with increasing size measured as biomass when plant size variation was due to variation in neighbour effects but not when plant size variation was due to soil resources. However, larger plants were not more female when plant size variation was due only to variation in soil resources. Hence, only the pollen dispersal hypothesis is supported.

**Assistants:** Robert Laird, Rebecca Snell

### **Thesis:**

Laird, R. (2000) Productivity and diversity in an old field plant community: a randomized null model of the "selection probability effect". B.Sc. Thesis, Department of Biology, Queen's University, Kingston, Ontario

***Dr. Chris Eckert***

## **“Ecology and Evolution of Plant Reproductive Strategies”**

**Celine Muis- "Experimental analysis of biparental inbreeding in a self-fertilizing plant, *Aquilegia canadensis* (Ranunculaceae)"- B. Sc. Thesis**

Natural populations of plants and animals may often be spatially structured so that related individuals live in close proximity to one another. This kin-structuring may lead to considerable inbreeding, especially in sessile organisms like plants where mating is mediated by abiotic or biotic pollen vectors. Theoretical models have shown that the degree of "biparental" inbreeding can affect the evolution of the level of self-fertilization because crossing among relatives reduces the genetic cost of cross-fertilization compared to self-fertilization. Although the evolution of selfing vs. outcrossing is probably the most prevalent evolutionary pathway in plants and has been the focus of much research activity over the past two decades, the degree of biparental inbreeding has never been experimentally estimated in natural plant populations. I used a novel transplant experiment to estimate biparental inbreeding in columbine, *Aquilegia canadensis*, exhibits a high level of selfing (average = 75%, range among populations = 15%-100%), the evolution of which has been the focus of a series of studies at QUBS over the past four years. To estimate the level of biparental inbreeding in two populations, I randomly repositioned 50 plants within each population and compared this group of "moved" plants to 50 control plants which had been dug up but planted back in their original position. If biparental inbreeding occurs regularly, we would expect the seeds of these moved plants to be less inbred than the seeds of control plants, because the moved plants had been moved out of their original genetic neighbourhood. I collected seeds from each experimental plant plus a large sample of unmanipulated plants in each population and assayed these seeds for polymorphic allozyme loci to estimate the level of inbreeding. In both populations, moved plants exhibited much lower levels of apparent inbreeding than control plants, indicating that mating among relatives occurs regularly in these populations and may have a significant influence of the evolution of the mating system.

**Assistant:** Michael Bhardwaj

***Dr. R. Harmsen and Dr. S. Blatt***

## **“Long Term Succession Project”**

This project, which was started in 1975, is now at a stage where the rate of change in the vegetation is much slower than it was in the first twenty years. After the major assessment of the vegetation and sampling of the insect fauna in 1999, the year 2000 field season was limited to a few visits to check that the enclosures were in place etc. Most of the research emphasis was on lab identifications of specimens, analyses of results, and manuscript preparation. For the year 2001 field season, insect sampling and general vegetation analysis is planned.

**Assistant:** Melissa Notman

*Dr. Peter Hodson* – Queen’s Department of Environmental Science

### **Environmental Toxicants in Aquatic Environments**

**Alice Winchester - The toxicity of retene to bluegill embryos - M.Sc thesis**

To further understand the toxicity of retene (a polycyclic aromatic hydrocarbon) to fish it is important to assess the sensitivity of various species. In June 2000, I assisted Bryan Neff and Peng Fu (University of Toronto) in collecting Bluegill from Lake Opinicon to obtain fertilized eggs. These eggs were used for an early life stage toxicity test, which involved exposing the embryos to a gradient of retene concentrations throughout their development and identifying subsequent abnormalities. The experiment allowed us to compare species susceptibility to this toxicant and will aid in distinguishing characteristics that may increase vulnerability. Bluegill larvae had a similar sensitivity to retene as rainbow trout, which was greater than zebrafish and medaka but less than walleye and herring.

*Jim D. Karagatzides* (Queen’s Geography) and *Dr. Len J.S. Tsuji* (Environmental Science, University of Waterloo)

### **“Potential effects of bismuth shotgun pellets on southern Ontario sugar maple forests and wetlands”**

Bismuth has been proposed as a non-toxic alternative to replace lead shot pellets yet data on its potential impact to plants, soil and wildlife is scanty. In addition, persistent acidic deposition may lead to mobilization of bismuth pellets in terrestrial and aquatic ecosystems. To examine the potential effects of bismuth pellets on forests and marshes in southern Ontario, we established long-term monitoring plots in a sugar maple forest and marsh at QUBS in 1999. In each environment, 24 plots were established and assigned to one of four treatments: bismuth, acidifying agent (ammonium sulphate pellets), bismuth plus acidifying agent, or control (no bismuth or acidifying agent). Forest plots are 5m by 5m centered on mature trees while plots in the marsh are 1m in radius. The acidifying agent is applied annually whereas bismuth pellets were applied once in November 1999 at average published rates of lead pellets in the environment: 50 pellets m<sup>-2</sup> for upland forests and 200 pellets m<sup>-2</sup> for wetlands. At the end of the study, we will examine before versus after treatment comparisons for soil chemistry (pH, bismuth and other elements), vegetation biomass, chemical status of wetland and forest herbs, and tree ring increment growth and chemistry.

*Dr. Allen Keast*

### **"Fish and bird communities: A comparison"**

Assemblages relative to habitat features and ecosystems are a basic feature of animal systems. Comparative studies on the nature of these in fish and birds in the Lake Opinicon research area, despite basic differences between aquatic and terrestrial systems, show many similarities. The clustering of components of the landscape relative to physical features in the environment produces specific kinds of ecological opportunities to which many species, despite

different needs, can relate. In each there is a spectrum of foods of different types and sizes, the harvesting of which requires special structures: species can specialize on the different sizes. Space use and clustering patterns, seasonal usages of resources, etc. are commonly different in the two systems.

Quantitative as well as qualitative differences commonly reflect differences in the contrasting water and air media. Deeper considerations and quantification involve such aspects as proportionate representation of different guilds, and biomasses of species relative to richness of prey resource base.

***Drs. William Leggett and Tom Johnson***

**Heidi Swanson - Trophic positions and mercury concentrations of native forage fishes and rainbow smelt in lakes of northwestern Ontario - B.Sc. thesis**

**Collaborators:** Drew Bodaly, Department of Fisheries and Oceans, Winnipeg; Rick Doucett, and Rick Cunjak, Department of Biology, University of New Brunswick, Fredericton.

The objectives of this research were to determine where rainbow smelt fit into the food webs and how they influence mercury transfer to higher trophic levels in lakes of northwestern Ontario. Rainbow smelt are a recent invader in this region and there is some evidence that native piscivores in these lakes have experienced increased mercury bioaccumulation since the arrival of smelt. Ten lakes (5 with smelt, 5 without) were sampled for smelt, native forage fishes, and clams in August 2000. The trophic positions (as determined by stable isotope analyses) and mercury concentrations of all fishes were compared. This project used the QUBS facilities for testing field equipment prior to the sampling trip to northwestern Ontario. Key equipment necessary for the trip, including a boat, motor, and boating accessories were borrowed from the field station. In addition, QUBS personnel provided considerable assistance and advice in the selection, preparation and maintenance of the field equipment prior to departure.

**Assistant:** Tom Herra

***Dr. Robert Montgomerie***

**Stephen Casselman - Sperm traits and body condition of male bluegill - B.Sc thesis**

Though there has been some recent interest in the variation in sperm traits among males of a population, reasons for this variation have not yet been determined. In this study we looked at the relation between sperm morphology and behaviour (swimming speed and longevity) and the condition of breeding male bluegill in Lake Opinicon, Ontario. Sperm traits varied significantly more among than within males suggesting that some aspect of male quality might influence sperm morphology and behaviour. Our results show that males nesting in the centre of the colony produce sperm that are shorter and milt that is more concentrated with sperm than those nesting on the perimeter. We believe that this may be a result of varying levels of sperm competition. We also found that males in poorer condition during spawning had faster sperm. This may be caused by males investing different amounts of energy into producing sperm. This study is the first to investigate the relationship between condition, male nest location and sperm quality.

**Frank Phelan**

### **Management Implications of Angling Regulations**

Continuing a long period of cooperative study (since 1989), students hired under agreements with Ontario Ministry of Natural Resources conducted field research with Dr. Dave Philipp's group from the Illinois Natural History Survey. Details of the work will be found later in this report under Dr. Philipp's name. In addition to the research, students carried out Nearshore Community Index Netting of Newboro Lake in August and analyzed data from Spring Littoral Index Netting of Lake Trout from Charleston Lake and Nearshore Community Index Netting from Beverley Lake.

**Assistants:** Cory Suski and Matt Coombs.

**Dr. Laurene Ratcliffe**

### **"Acoustic communication and mate choice"**

Scott Tarof - Sexual and natural selection in least flycatchers: why do breeding birds cluster? - Ph.D. thesis.

Least Flycatchers (*Empidonax minimus*) are socially monogamous suboscines that breed throughout much of North America. Males defend all-purpose territories (i.e. where nesting, feeding young, and copulation co-occur) that are commonly found in tight territorial aggregations (2-33 territories per cluster; 5-8 clusters annually at QUBS). A small proportion of males in our population defend solitary territories away from clusters. For the past four field seasons I have addressed two main project objectives: (1) to describe cluster configuration, and (2) to examine the adaptive significance of clustering behaviour in this species. My project is the first to examine possible natural and/or sexual selection mechanisms for this territorial clustering in a socially monogamous bird.

I test three main hypotheses for clustering in least flycatchers. The material resources hypothesis states that the distribution of ecological elements (e.g. vegetation features, insect abundance) provides preferential breeding sites to which birds respond. The predation hypothesis suggests that clumped nesting may be an adaptive response to reduce predation. The hidden lek hypothesis holds that birds aggregate breeding territories for extra-pair matings, just as lekking species cluster for promiscuous matings.

To test the material resources hypothesis, I quantified habitat characteristics by sampling vegetation features and insect abundance inside and outside clusters. I monitored nesting success to compare predation rates in relation to territory position. To test the hidden lek hypothesis, I used mist nets to capture and bleed a total of 98 adults. Parentage analyses using four microsatellite loci were performed on 24 complete family groups, despite nest heights of 5-20m. Typical morphometric and age data were collected from each bird caught. I collected extensive data during morning focal watches on mating behaviour and male song output. Territory boundaries were mapped using GPS.

My data most strongly support the hidden lek hypothesis. The single best predictor of male social and genetic mating success is being a territory holder in the centre of a cluster. Solitary males have an extremely low probability of attracting a social mate. At the scale measured, habitat features do not appear to explain territorial clustering in this species. However, at the landscape level, clusters nearly always form adjacent to bodies of water (e.g. swamps, lakes, or streams) which undoubtedly provide important food sources for this insectivorous bird. I am currently developing the idea that clustered versus solitary settlement may be two alternative male mating strategies in least flycatchers. Males that settle in a cluster benefit from higher pairing success and from the opportunity to increase their realized reproductive success through extrapair matings, but trade-off high rates of nest predation. In contrast, by settling away from clusters, solitary males trade-off extrapair matings but have a higher chance of successfully raising young – if they can attract a social mate.

**Assistants:** Michael Kasumovic, Tahir Feroz.

### **A word of thanks**

I am within two months of thesis submission. I have thoroughly enjoyed my four years at QUBS. I owe a tremendous debt of gratitude to the many first-class field and laboratory assistants, as well as to Raleigh Robertson, Frank and Marg Phelan, Floyd Connor, and the kitchen staff, with whom I have had the privilege of working. I am looking forward to my fifth field season working on a related least flycatcher project with a new colleague and friend,

Michael Kasumovic – only this time I will be the field assistant that is free from decision-making obligations for the first time in my academic career.

### **Daniel Mennill - The song system and mating system of the Black-capped Chickadee: Communication networks and female choice - Ph.D. thesis**

The 2000 field season was the second year of my investigation of the song system and mating system of the Black-capped Chickadee (*Poecile atricapilla*). In January I banded 136 birds at 14 feeding stations around the Station Point. The winter population of chickadees was slightly smaller in 2000 than in recent years (~169 birds in 1999, ~194 birds in 1998), however the number of birds that remained on the property until the breeding season matched previous years.

In February and March I established winter flock hierarchies by observing chickadees interact at experimental dominance feeders. From April to June I monitored 65 breeding pairs. I recorded the dawn choruses of most males, monitored the feeding rates of all pairs, and sampled the blood of nestlings from 40 broods. I used a global positioning system to map nest locations and territory boundaries as well as female movements during focal behaviour watches.

During the breeding season in early May, I continued a playback experiment which began last year. I tested whether females eavesdrop on the vocal interactions of territorial males by engaging males in song contests with simulated intruders. I used two interactive playback treatments to demote high-ranking males and promote low-ranking males. I assessed whether females changed their reproductive decisions in response to playback sessions by radio-tracking females to test for extra-territorial forays and extra-pair copulations. In addition, I tested for extra-pair fertilizations in the nests of playback subjects by performing microsatellite paternity analysis in Queen's University Molecular Ecology Laboratory. Preliminary evidence from



paternity analysis suggests that females changed their reproductive strategy after eavesdropping on a male-male song contest where their mate lost to a simulated intruder.

In February I mounted 176 nest boxes around the Station Point. I arranged these boxes in groups of four, allowing female chickadees free choice of nest hole orientation. Despite low levels of box occupancy in 2000, records of nest choice over the coming years will allow me to assess whether chickadees preferentially orient their nest cavities in one particular direction.

In April 2000, I conducted a pilot investigation of chickadee plumage colouration. Using a spectrometer I collected precise colour measurements of eight body regions. Preliminary evidence shows that while male and female chickadees may look the same to the human observer, they may be sexually dimorphic in the eyes of other chickadees. Furthermore, high-ranking and low-ranking chickadees may share different plumage characteristics, such that individual quality is reflected in a chickadees plumage.

In upcoming field seasons I will expand my investigation of the behavioural ecology of black-capped chickadees with further playback experiments and continued monitoring of nest choice and colour variation. You can read more about chickadee research at QUBS on the internet (<http://biology.queensu.ca/~mennilld>).

**Collaborators:** Pete Christie, Stephanie Doucet

**Assistants:** Ryan DeBruyn, Dev Aiama, Bridget Meigs

**Volunteers:** Gillian Glen-Worrall, Jason Pither

**Peter Christie - "Song structure and singer quality in Black-capped Chickadees" -  
M.Sc. Thesis**

Spring 2000 was my second field season for exploring whether the fine structure of male black-capped chickadee songs might provide useful information to distant listeners about the quality of the singers. The work involved recording the dawn chorus songs of banded male chickadees in the well-studied population of the birds around QUBS. I later analyzed the songs in the lab, looking for characteristic frequency and note-duration attributes that might reflect the bird's dominance status within his winter flock (this dominance data was collected by Dan Mennill and Ryan DeBryun throughout the winter). I also evaluated how well many of these songs survived distance transmission, by broadcasting my recordings through the morning forest and re-recording them at 5, 40, 60 and 80 m. Another analysis of song frequency and duration measures allowed me to assess how well the songs retain information about male quality and/or identity at different distances.

With considerable early morning help from Dan Mennill, Ryan DeBryun, Dev Aiama and Bridget Meigs, almost 50 male chickadees of known social status were recorded between April 23 and May 15. My distance broadcast experiments were carried out in early May along a level transect near the Lindsay Lake trail.

Early findings suggest males who rank high in their winter flocks make characteristic changes in the structure of the "fee-bee" song as they transpose it up and down a frequency range. Low-rank males, on the other hand, appear unable to accommodate these structural changes. These findings suggest listening females may be able to evaluate singer quality on the intrinsic basis of his performance alone without relying on comparisons with the performances of other birds. Discriminant function analysis also suggests the fine structure of chickadee songs is

individually distinctive, allowing for, in many cases, the easy identification of a singer by his song. This individual distinctiveness appears to remain intact for songs of high-rank birds broadcast across long distances, but less so for low-rank singers. Analysis is ongoing.

**Assistants:** Dan Mennill, Ryan DeBruyn, Dev Aiama, Bridget Meigs.

**Bridget Meigs - "Communication within pairs of black-capped chickadees (*Poecile atricapilla*) during incubation and brooding" - B.Sc. thesis**

This study examines the structure and usage of the "faint fee bee" call, used by male and female chickadees to co-ordinate parental activities at the nest. Analysis of the nest co-ordination efforts of 17 pairs, and a structural analysis of faint fee bee recordings shows: 1) that calling behaviour varies markedly among pairs, 2) that faint fee bee calls are individually distinctive, and 3) that the structure of the faint fee bee differs significantly from that of loud fee bees (used in long distance communication), in both frequency and temporal components. A playback experiment was also carried out to determine whether incubating females can discriminate between broadcast of synthesized versions of their mates' and stranger's faint fee bees.

**Publications:**

Tarof, S.A., L.M. Ratcliffe and P.T. Boag. 2001. Polymorphic microsatellite loci for assigning parentage in least flycatchers (*Empidonax minimus*). *Molecular Ecology Notes*. (in press)

Tarof, S.A. and L.M. Ratcliffe. 2000. Pair formation and copulation behavior in least flycatcher clusters. *The Condor* 102:832-837.

Mennill, D. J. and L. M. Ratcliffe. 2000. A field test of Syrinx sound analysis software in interactive playback. *Bioacoustics* 11: 77-86

Ramsay, S.M., Otter, K.A., Mennill, D. J. Ratcliffe, L. M. and P. T. Boag. 2000. Divorce and extra-pair mating in female black-capped chickadees (*Parus atricapillus*): separate strategies with a common target. *Behavioral Ecology and Sociobiology* 49: 18-23.

***Dr. Raleigh J. Robertson***

**"Behavioural Ecology and Conservation Biology of Birds"**

Year 2000 was an eventful field season for the RJR bird lab. Between involvement in final stages of construction, furnishing, moving in and making the new "Operations Centre" operational, we did manage to have a very successful season. Jason Jones, having completed data collection for his Ph.D., and busy writing for an October defense, helped with the transition of the Cerulean Warbler project to the next stage. M.Sc. student Jenn Barg, with field assistance from Ryan DeBruyn, SWEP student Andrew Stewart and valued volunteer from Mexico, Jesus Vargas, completed her second field season on the Cerulean Warbler Project, examining fine details of space use within territories.

Tim Demmons, finished with field work for his M.Sc. on Golden-winged Warblers, which he defended in September, spent some time with incoming M.Sc. student Rachel Fraser, helping ensure continuity in locating territories and nesting birds. Rachel's new study will examine paternity in GWWA's, as well as molecular genetics of hybridization with Blue-winged Warblers.

Our long term studies of Tree Swallows continued, with summer NSERC student, Amy MacDougall, keeping the population banded, blood sampled and nest-monitored. Finally, honour's student Gillian Glen-Worrall did her thesis project using a food supplementation experiment with Eastern Bluebirds. Gillian examined possible trade-offs between foraging and mate guarding, and will also examine possible effects on paternity.

**Jennifer J. Barg - Intra-territory spatial and habitat use by male Cerulean Warblers - M.Sc. thesis**

The focus of my thesis has been to delineate those areas within male Cerulean Warbler territories that are used most frequently, and to then determine their function. This involves both spatial (delineation of the core areas) and behavioural (determination of function) components. We hope that such a fine scale investigation might provide more detailed information on Cerulean Warbler habitat requirements and behavioral ecology during the breeding season.

The summer of 2000 was a very productive data collection season. We were successfully able to collect detailed spatial and behavioural data on 17 male Cerulean Warblers. We simultaneously succeeded in collecting demographic data for the population at the Bedford Mills study site, completing the 7th year of such information. We have since submitted a manuscript on Cerulean Warbler survivorship, which is currently in review.

**Assistants:** Jason Jones, Ryan DeBruyn, Andrew Stevens

**Amy MacDougall - Long-term studies of Tree Swallows - NSERC Summer Student**

Although primarily socially monogamous, studies of tree swallows (*Tachycineta bicolor*) have shown that extrapair copulations are frequent and that many nests contain young not descendent from the resident male, a pattern found to varying degrees in most passerine birds. The high numbers of tree swallows and their acceptance of artificial nest boxes make them an excellent study species for examining this prevalent avian mating system.

The population of tree swallows at the Queen's University Biological Station has been monitored extensively for the past two decades, establishing a rare and valuable data set. During the 2000 field season, study of the tree swallows breeding in QUBS= 250 nest boxes included collection of morphometric measurements, breeding phenology information, and blood samples for genetic and protein analyses. These data have been integral to the maintenance of the long-term data set and will be used to further examine rates and patterns of extrapair paternity, as well as address new questions concerning fertilization order and the potential role of Major Histocompatibility Complex (MHC) genes in tree swallow mate choice.

**Jason Jones - Assessing conservation utility: a case study of the Cerulean Warbler in eastern Ontario - Ph.D. thesis defended 19 October 2000.**

**Publications:**

Jones, J., and R. J. Robertson. Territory and nest-site selection of Cerulean Warblers in eastern Ontario. *Auk* (Accepted 1 December 2000).

Jones, J., R. D. DeBruyn, J. J. Barg, and R. J. Robertson. in press. Assessing the effects of natural disturbance on a Neotropical migrant songbird. *Ecology*.

Jones, J. in press. Habitat selection studies in avian ecology: a critical review. *Auk*.

**Gillian Glen-Worrall - Breeding ecology of eastern bluebirds - B.Sc. thesis**

During the summer of 2000, I worked at QUBS as a 4th year honours student under the supervision of Dr. R.J. Robertson. My thesis, entitled “The Effect of Resource Availability on Mate Guarding and Paternity in Eastern Bluebirds (*Sialia sialis*): A Food Supplementation Experiment”, was part of a collaborative project involving Dr. Wallace Rendell and Dr. Robertson, and funded in part by the North American Bluebird Society.

Male Eastern Bluebirds (*Sialia sialis*) are influenced by many demands during the breeding season, namely territory defense, mate guarding, food acquisition, and nestling feeding. Male bluebirds spend time guarding, or maintaining a close association with, their mates so to prevent her from having opportunity to copulate with another male. In a territory rich with food resources, males may be expected to contribute more time to mate guarding, territory defense, and nestling care. Consequently, increased mate guarding may result in food supplemented nests having fewer young sired by other males. To test this, I provided half of the breeding pairs with supplemental food (12g mealworms) on a daily basis over the breeding season. By combining field behavioural observations with molecular paternity analysis, I will be able to compare the effects that resource availability may have on the behaviours of the adults, the paternity of nestlings, as well as overall reproductive success in eastern bluebirds.

**Rachel Fraser - Breeding biology of Golden-winged Warblers (*Vermivora chrysoptera*) and hybridization with Blue-winged Warblers (*V. pinus*): implications for a declining species - M.Sc. thesis**

Golden-winged Warbler numbers have been declining for the past thirty years. This decline is thought to be the result of a decrease in available breeding habitat, and more importantly, hybridization with Blue-winged Warblers (a sister species that competes for the same ecological niche). Populations of Golden-winged Warblers and Blue-winged Warblers that have traditionally been allopatric are now coming into contact due to human-caused habitat change, with potentially devastating implications for Golden-winged Warblers. Due to the rapid introgression of Blue-winged Warbler DNA into Golden-winged Warbler populations, Golden-winged Warblers cease to exist in a given area within fifty years of contact between these two species. At QUBS we have a population of Golden-winged Warblers that are not in direct contact with Blue-winged Warblers, providing us with a unique research opportunity. If we can determine the mechanisms that cause the disappearance of Golden-winged Warblers from a given area, we can better protect those populations that remain allopatric. This research is

paramount considering the ongoing encroachment of Blue-winged Warblers on Golden-winged Warbler populations.

During the summer of 2000 I spent a week at QUBS seeking out Golden-winged Warblers and learning the ropes from outgoing M.Sc. student Tim Demmons. Not only did this provide me with the chance to study Golden-winged Warbler behaviour in the field, it gave me the opportunity to get to know QUBS property. In addition to this preliminary behavioural work, on several occasions Tim and RJR took me out for some trial mist-netting. This pilot study was a valuable experience and I'm sure it will aid me greatly when I head back to QUBS in May 2001.

*Dr. John P. Smol*

**"Establishing Development Guidelines for Lake Watershed Management in South-eastern Ontario using a Multi-Proxy Paleolimnological Approach"**

**Investigators:** Kimberley E. Neill, Francine Forrest, E.D. Reavie, J.L. Little and John P. Smol  
**Kimberley E. Neill, E. D. Reavie, J. Little - "Paleolimnological reconstructions using subfossil Chironomidae (Diptera) and Diatoms (Bacillarophyceae) as indicators of deepwater dissolved oxygen depletion and nutrient levels in two Southeastern Ontario Lakes"**

Increased lake productivity resulting from cultural activities such as land clearance and cottage development can cause an increase in nutrient levels and a subsequent decrease in deepwater dissolved oxygen (DO). Depleted deepwater DO is a serious problem because it can result in the displacement and death of benthic fish and invertebrates, and cause the release of toxic substances, such as heavy metals and phosphorus from the sediment. This study demonstrates that taking a multi-proxy paleolimnological approach to reconstructing past lake conditions can provide a holistic understanding of past environmental lake conditions. In our study, diatom remains (siliceous algae) were used to reconstruct past nutrient levels, and subfossil midge (Chironomidae, Diptera) larvae provided proxy historical data to reconstruct deepwater DO levels. The main objectives of our paleolimnological research were to determine and compare pre- and post-settlement nutrient and deepwater DO regimes in the recently undisturbed Round Lake (on the QUBS Pangman Conservation Reserve) and a moderately culturally disturbed lake (Hambly Lake) over the past ca. 200 years, and to propose realistic mitigation and management guidelines for these lakes.

Prior to human settlement, the diatom and chironomid assemblages indicate that the nutrient conditions in Round Lake were oligotrophic and deepwater DO was high. With the onset of cultural development surrounding the lake, there were shifts in both assemblages indicating that there was an increase in nutrient levels and a subsequent decrease in deepwater DO. The high nutrient levels and hypoxic conditions during cultural development may have resulted from disturbances such as logging, mining and railroad construction surrounding Round Lake. The land surrounding Round Lake has now been converted into the Pangman Conservation Reserve and cultural development activities are no longer taking place within the catchment. Final shifts in the diatom and chironomid assemblages indicate that the nutrient and deepwater DO conditions have returned to pre-cultural development conditions.

In Hambly Lake the post-settlement changes in diatom and chironomid assemblages are subtle despite moderate cultural disturbance within the catchment. We concluded that this lake has had relatively high nutrient levels and is naturally anoxic for the past ~200 years.

In terms of lake management, the recent conversion of the Round Lake catchment to conservation reserve has contributed to the restoration of nutrient and deepwater DO levels to conditions similar to those prior to cultural development, demonstrating the resilience of this lake system. In contrast, Hambly Lake's nutrient and deepwater DO levels have not been greatly affected by moderate levels of cultural activity. Hence, mitigation efforts to decrease nutrient levels or increase deepwater DO levels will likely not be effective, as this lake had naturally high nutrient levels and low deepwater DO conditions. This study demonstrates that chironomids are robust paleolimnological indicators and can be used in conjunction with diatoms and other proxy data to develop a holistic understanding of how lakes like these respond and recover from varying degrees and types of cultural disturbance.

**Francine Forrest - "A paleolimnological comparison of trophic state responses to anthropogenic disturbances of several lakes within the Rideau Canal System, Ontario" - M.Sc. thesis**

Diatom-inference paleo-techniques are used to reconstruct total phosphorus in Indian, Big Rideau, Lower Rideau and Otter lakes located along the Rideau Canal System. This information is useful for making lake management decisions, as it can be used to distinguish human-induced trophic shifts from natural variability. Additionally, this study compares the trophic state responses of these lakes to canal construction and other anthropogenic disturbances over the last ~200 years. A detailed investigation is warranted, as past paleolimnological studies have found differing responses to these disturbances, particularly those associated with canal construction. Paleolimnological evidence from Lake Opinicon (Karst and Smol, 2000) and Sand Lake suggests that shallow macrophyte-dominated lakes experienced minimal changes in trophic status associated with the time of canal construction, whereas, deep mesotrophic to eutrophic lakes (i.e. Upper Rideau Lake) experienced significant changes in diatom assemblages.

A transfer function, recently developed from 64 lakes within southern Ontario, is applied to the down-core diatom data to reconstruct past lake-water [TP] (Reavie & Smol, 2001). This study further explores the discrepancy of trophic responses between lakes of varying morphometry and macrophyte growth.

**Publications:**

Karst, T.L. and J.P. Smol. 2000. Paleolimnological evidence of a clear-water trophic state equilibrium in a shallow, macrophyte-dominated lake. *Aquatic Sciences* 62: 20-38.

Little, J. and J.P. Smol. 2000. Changes in fossil midge (Chironomidae) assemblages in response to cultural activities in a shallow polymictic lake. *J. Paleolimnology* 23: 207-212.

Little, J. and J.P. Smol. A chironomid-based model for inferring late-summer hypolimnetic oxygen in Southeastern Ontario lakes. *J. Paleolimnology* (accepted).

Reavie, E. and J.P. Smol. 2001. Diatom-environmental relationships in 64 alkaline southern Ontario (Canada) lakes: a diatom-based model for water quality reconstructions. *Journal of Paleolimnology* (in press).

*Dr. Bruce Tufts*

**Physiological Aspects of Catch-and-Release Angling on Fish**

Students from my lab collaborated with Frank Phelan (QUBS) and Dr. David Philipp (Illinois Natural History Survey) on studies of black bass management. My students gained hands-on (in-water) experience in ecological studies and familiarity with natural populations of bass. In addition, collections of bass were made for physiological work in the lab at Queen's.

**Assistants:** Cory Suski, Michael Morrissey-Flynn and Shaun Killen

*I: Research conducted by non-Queen's Researchers in 2000*

**Drs. Robert L. Baker** (Department of Zoology, Erindale College, University of Toronto) and **Mark R. Forbes** (Department of Biology, Carleton University, Ottawa)

**Christopher Yourth - Ecological Immunology of Lestid Damselflies - M.Sc thesis**

I am investigating the ecological and evolutionary factors which govern energetic investment made by hosts or potential hosts in defenses against parasites. I am interested in the role played by condition and the trade-offs involved between immune function and other biological functions, particularly thermoregulation (for reasons explained below). During the summer of 2000, I used the lestid damselflies *Lestes forcipatus* Rambur and *Lestes congener* Hagen as model species with which to study the factors affecting immune investment. I used their natural parasite, the water mite *Arrenurus planus* (Marshall), and simulated parasites in the form of Sephadex beads to stimulate responses by the host damselflies. Damselfly immune responses to mites (in this case) take the form of cellular responses directed at the mite's feeding tube in the form of plasma coagulation, encapsulation by host haemocytes and melanin production. Melanin is also important for the thermoregulation of the damselflies, setting the stage for a trade-off between thermoregulation and immunity.

**Assistant:** Marc Lajeunesse

**Dr. Mark Forbes** (Department of Biology, Carleton University, Ottawa)

**Local Adaptation and Ecological Immunology**

My latest research at QUBS is framed in the emerging sub-disciplines of ecological immunology and local adaptation (collaborators: Drs. Brian Leung, Rob L. Baker, Bruce P. Smith; see separate entries for Baker and Smith). As in previous field seasons, we use dragonflies to test assumptions and predictions concerning allocation of an organism's time or energy budget to immune function. We also are examining the degree to which local parasites are adapted to locally abundant hosts by comparing their performance on hosts from local versus distant populations. Our work is not restricted to parasites of odonates. This past year, David McRuer used principles established in the field of disease ecology to examine the risk from baitshops spreading pathogens to frog populations. And Alex Wong searched for genetic markers for female morphs of damselflies.

**Dr. Brian Leung** (University of Cambridge, UK ) - PDF.

Dr. Leung is a collaborator and this past year he completed a study on the effects of nutritional stress on ability of damselflies to engage in anti-parasite behaviour. His work shows that damselfly larvae fed on poor diets were less able to remove larval mites, that efficacy of removal is largely dictated by grooming behavior and that other behaviours are less affected or unaffected by nutritional stress. His work clearly shows that individuals in poor condition at emergence may carry above-average parasite loads. Whether ectoparasites cause poor condition



or are simply a signal of poor condition has confounded many studies on the combined effects of stress and parasitism on host fitness and whether these effects translate into population effects. Brian was able to disentangle these effects by studying host susceptibility to attachment by mites, in the absence of actual parasitism.

**Marc Lajeunesse** (Department of Biology, Carleton University) - **The role of insect metamorphosis in combating parasites** - M.Sc. thesis

Marc was a field assistant for Chris Yourth and David McRuer, but during this field season he also engaged in studies on metamorphosis of insects and its relation to combating parasites. He also is leading the studies on local adaptation and addressing why there is such inconsistency of views on parasite local adaptation in the recent ecology and evolution literature. He plans to return to QUBS in 2001 and address factors accounting for this disparity of results using field studies of dragonfly species that differ in their susceptibility to a generalist mite parasite. Most studies of local adaptation are on generalist parasites but researchers have not considered whether hosts chosen for study are main or ancillary hosts.

**David McRuer** - (Department of Biology, Carleton University) - **Prevalence of Red-leg bacteria in local frog populations** - M.Sc. thesis

David asked two related questions this past summer. First, he explored the extent to which four species of ranid frogs differed in their background prevalence of *Aeromonas hydrophila* infections. This bacterium causes lethal red-leg disease in frogs, mouth rot in snakes and a host of subclinical effects in fish. His main purpose in this first stage of his studies was to determine the extent to which leopard frogs currently used by the baitshop industry in Ontario are potential vectors for *A. hydrophila*. David showed that the high prevalence of *A. hydrophila* on leopard frogs accounted for highly significant among-species variation in prevalence, but that juvenile leopard frogs (most often used by baitshops) were considerably less infected than adults. Second, he compared measures of immunosuppression and immunodiversion of baitshop frogs and control frogs to determine the extent to which baitshops release immunologically challenged and potentially diseased frogs back into local habitats. This research relies on obtaining counts of various white blood cells and comparing investment into immunological versus non-immunological organs (e.g., spleen versus kidney). These results will be forthcoming.

**Assistants:** Jen McRuer, Marc Lajeunesse

**Alex Wong** - (Department of Biology, Carleton University) - **Genetic markers for female morphs in damselflies** - B.Sc. thesis

Alex has sampled damselflies from around QUBS to assess whether genetic markers for females morph type could be isolated. This work is a necessary first step to later experiments on frequency-dependent selection in damselflies. In collaboration with Dr. Myron Smith (also at Carleton), we screened some 170 PCR products and discovered that some were hypervariable and could be used for paternity or other such studies. However, this work will be costly and time consuming. Other less expensive methods for experiments are being sought based on proxies of fitness for various female morphs. Using Alex's data, however, we can address certain aspects

such as whether neutral markers differ between populations where morph frequencies are known to differ and the extent to which AFLPs versus RAPDs produce reliable estimates of individual and population levels of heterozygosity.

**Publications:**

Leung, B., Forbes, M.R. and Baker, R.L. (in press). Stress and behavioral immunity of damselflies. *Animal Behavior*

**Theses**

Wong A, 2000. Characterization of AFLP markers in an insect: prevalence of co-dominant markers and implications for population genetic applications. B.Sc. thesis, Department of Biology, Carleton University, Ottawa, Ontario

**Dr. Michael Fox** - Environmental and Resource Studies Program and Department of Biology, Trent University, Peterborough, Ontario

**"Variability in Life History Traits of Pumpkinseed Sunfish"**

The long-term objectives of my research are to explain the high degree of life history variation exhibited by pumpkinseed (*Lepomis gibbosus*) populations. Some of my early research showed that pumpkinseed populations living in sympatry with bluegill sunfish exhibit delayed maturity and maturity at a smaller size than pumpkinseed inhabiting waterbodies without this juvenile competitor. Two of the lakes in my study area that were allopatric in the early 1990's have since been invaded by bluegills, and these populations have grown steadily. I am continuing to monitor the life history traits of pumpkinseed populations in these lakes, along with several others that remain allopatric in order to determine whether the bluegill are affecting the pumpkinseed populations in these lakes.

In addition, I am continuing to monitor life history traits of four other pumpkinseed populations on an annual basis to provide long-term data on annual variability of these traits. One of the four populations is that of Lower Poole Pond, located on QUBS property near the Opinicon Cemetery.

**Assistant:** Rashpal Dhillon

**Publications:**

Fox, M.G., and A.J. Crivelli. 2001. Life history traits of pumpkinseed (*Lepomis gibbosus*) populations introduced into warm thermal environments. *Arch. Hydrobiol.* (in press).

**Dr. James Fullard** - Department of Zoology, Erindale College (University of Toronto), Mississauga

## **Insect Sensory Ecology and Neuroethology**

### **Dr. James Fullard & Nadia Napoleone - Diel flight periodicity and the evolution of defensive sensory adaptations in the Macrolepidoptera**

We measured the 24-hour flight activity patterns of 84 species of Nearctic Lepidoptera representing 12 ultrasound-earless and seven ultrasound-eared families to examine the evolution of the diel flight periodicities (DFPs) and auditory defences of these insects. Most species tested exhibited mixed DFPs (flight during day and night hours) with few being exclusively nocturnal. With the exception of one geometrid and one arctiid, only the butterflies (Papilionoidea + Hesperioidea) are exclusively diurnal, supporting the hypothesis that this trait has resulted from their lack of ultrasound-sensitive ears, structures that in most other Macrolepidoptera provide auditory defence against aerially-foraging, insectivorous bats. Eared species exhibit the highest tendency to fly during both day and night, a trait we suggest results from their possession of both visual and auditory defences. Earless moths are almost exclusively nocturnal and may be constrained to the night because of their size and tendency for ground-hugging flight, traits that, although provide protection against bats, would be liabilities against diurnal, visually-hunting predators. Ultrasound-sensitivity appears not only to protect eared moths from aerial predators (bats) but, by allowing them to remain in the air during the night, also protects them from terrestrial predators and, we suggest, is responsible for the success of this group of Macrolepidoptera.

**Acknowledgements:** Kit Muma, Amanda Soutar & Tarah Harrison assisted in the field. Natural Sciences and Engineering Research Council of Canada provided the funding.

### **Dr. James Fullard - Adaptation in the auditory receptors of Noctuid moths (*Catocala* spp)**

Certain authors have claimed that the two auditory receptors of the noctuid moth ear (A1 and A2) interact with each other at high sound intensities with the result being that the A1 receptor is inhibited. This hypothesis was challenged by Fullard et al., (1998) using the single-celled ears of prominent moths (Notodontidae). This summer I used the large ears of the noctuid moths, *Catocala* spp. to further test this hypothesis. Moths were exposed to very long pulses of ultrasound while their auditory nerves were extracellularly monitored. The receptor spiking that resulted from these stimuli adapted with time but there was no change in A1 adaptation rates whether A2 was activated or not suggesting that peripheral inhibitory interaction does not occur between these two receptor cells.

**Acknowledgements:** Kit Muma, Amanda Soutar & Tarah Harrison assisted in the field. Natural Sciences and Engineering Research Council of Canada provided the funding.

### **Amanda Soutar - The possible role of Vogel's Organ in predator detection in the Common Wood Nymph Butterfly (*Cercyonis pegala*) - B.Sc. thesis**

In 1912, Richard Vogel described a paired tympanal organ, positioned at the base of the wings of butterflies from the Satyridae family. At this time, Vogel declared the organ as a chordotonal organ, but only cautiously suggested an auditory function for this organ. Since that time, few researchers have revisited this organ, and no solid evidence has resulted that could determine its function. Despite this lack of evidence, most authors have attributed an auditory function to the Satyr's tympanal organ, despite the fact that this function has never actually been proven.

The use of ears to evade predators is not an uncommon one in the insect world. Resting stationary in the underbrush at night would leave diurnal butterflies vulnerable to nocturnal, insectivorous, terrestrial predators. For butterflies to be able to hear the approach of predators traveling through underbrush, or to hear the ultrasound that some predators produce, such as myomorph rodents, would increase their chances of survival.

Since predator evasion seems to be an obvious use for an auditory organ, and one that has long been assumed to occur, it would be interesting to find out if under experimental manipulation, the Vogel's organ does appear to play a role in predator evasion. If it is found that the Vogel's organ is not involved in this function, then the assumption that this organ is an ear will be found to be even less convincing. For this experiment, the satyrid species *Cercyonis pegala* was used. Ablated and non-ablated butterflies were exposed to a typical nocturnal, terrestrial, insectivorous predator, the white-footed mouse (*Peromyscus leucopus*). My prediction is that if the Vogel's organ is involved in predator evasion, then the time it takes for the ablated butterflies to be captured by the predator should be significantly less than the non-ablated butterflies, and interaction behaviours should differ. If the Vogel's organ is not involved, then there should be no significant difference in capture time or interaction behaviour.

### **Colony rearing of the Dogbane Tiger Moth, *Cycnia tenera***

As in past years, we raise and maintain a colony of tiger moths for research that is conducted in the Erindale laboratories at the University of Toronto. *Cycnia tenera* is an unusual moth species in that it is equipped with sound-producing structures (tymbals) on the sides of its thorax. The sound that are produced resemble those of cicada but differ in their almost completely ultrasonic character. The sounds can be elicited from adults by either touching them or by playing simulations of bat echolocation signals to them. This has allowed us a conveniently model for studying the sensorimotor integration of an insect to two forms of stimuli: tactile and acoustic. The experiments are conducted with adult moths that emerge from pupae prepared from the colonies we raise every summer at QUBS. These colonies are developed from the eggs of wild-captured females that we hatch and grow the larvae on local populations of dogbane. A percentage of wild-raised individuals are released to encourage the natural propagation of this species.

**Acknowledgements:** Kit Muma, Amanda Soutar and Tarah Harrison assisted in the field. Natural Sciences and Engineering Research Council of Canada provided the funding.

**Dr. Mart R. Gross** - Department of Zoology, University of Toronto

**Peng Fu - Alternative Reproductive Tactics and Sperm Production in Bluegill Sunfish** - M.Sc. thesis

This research is on the evolution of investment in sperm by alternative life histories. Empirical data were collected on sperm produced by cuckolder and parental male bluegill, and simulation models were also developed and run (with Bryan Neff) to allow calculation of fertilization success in the field using microsatellite markers. Two manuscripts, showing how sperm characteristics evolve, have now been submitted for publication (October 2000). Peng defended his M.Sc. in October 2000 is currently enrolled in the environmental law program at Queen's University.

**Thesis:**

Fu, Peng. 2000. Alternative reproductive tactics and sperm production in Bluegill Sunfish. M.Sc. thesis, Department of Zoology, University of Toronto, Toronto, Ontario.

**Dr. David P. Philipp** - Center for Aquatic Ecology, Illinois Natural History Survey, Champaign, Illinois and **Frank Phelan** - Queens University Biological Station

**Reproductive Ecology and Seasonal Movement of Smallmouth Bass in the Mississippi River Watershed**

For more than ten years, the INHS research team has been studying the reproductive ecology of smallmouth bass in the Mississippi River and Millers Lake. To date, studies have focused on monitoring the reproductive success of individual nesting male smallmouth bass. These data have permitted examination of recruitment mechanisms and nest-site fidelity which have aided in our ability to manage and conserve smallmouth bass populations. In 2000, we initiated a three year telemetry project involving thirty smallmouth bass. Fish of both genders, and from both lentic and lotic environments will be located approximately biweekly. During the reproductive period, fish will be monitored more frequently to permit detailed assessments of the pre and post spawn movements of smallmouth bass. This comprehensive project incorporating numerous assessment techniques will provide us with a clearer understanding of the ecology and energetics of smallmouth bass.

**Project Team Members:** Dr. David Philipp, Jana Svec, Steven Cooke, Dr. Chris Bunt, Cory Suski, Matthew Coombs, Jim Ludden, Julie Claussen, Kate Deters and Frank Phelan

**Physiological Ecology of Centrarchid Fishes**

Our research team has begun to undertake a variety of studies that will explore and elucidate the comparative physiological ecology of centrarchid fishes. We have been using a variety of techniques including heart rate telemetry, electromyogram telemetry, respirometry, swimming challenges, and cardiac output flow probes to answer basic and applied questions. In 2000, we undertook several projects. First, we initiated a study that will compare the physiological performance and energetics of six species of syntopic centrarchid fishes. These fish are all present in Lake Opinicon and exhibit substantial variation in parental care. We will attempt to test the theory that performance will vary with this variation in parental care. Second, we completed a study that examined the effects of silt on the physiology of lentic and lotic

populations of smallmouth bass. Third, we conducted a variety of experiments to assess the physiological and behavioural consequences of catch-and-release angling. Finally, we developed techniques for attaching heart rate transmitters to largemouth bass and then monitored their free-swimming metabolic rates to refine field energetics models for this species. Although these projects are principally physiological in nature, they will provide insight into the ecology and evolutionary biology of these species and will also contribute to our ability to manage and conserve centrarchid fish.

**Project Team Members:** Dr. David Philipp, Steven Cooke, Dr. Chris Bunt, Jason Schreer, Cory Suski, Kate Deters, and Frank Phelan.

**Dr. Chris Bunt** (NSERC Post-Doc), with **Steven Cooke** (University of Illinois) and **Dr. David Philipp** (Illinois Natural History Survey) - **Physiological Ecology**

This past year has been extremely productive and satisfying as the first year of my two year post-doctoral fellowship with NSERC. Several key projects were completed while working with researchers from the University of Illinois and the Illinois Natural History Survey at QUBS. The year began with preparations for a three year radiotelemetry study of seasonal movements and reproductive ecology of smallmouth bass in Eastern Ontario (Mississippi River). We used custom designed micro-processor controlled radio transmitters that switch off to save battery power during the night, thereby permitting us to track detailed behaviour and movement of male and female fish for three reproductive cycles. Our first year of data collection was exciting and by the summer of 2002, we will be prepared to produce the most detailed description of reproductive ecology, seasonal habitat selection and movement patterns ever documented for smallmouth bass. In April, I invented and tested a modified downrigger device to facilitate tracking of radio transmitters in deep water. A manuscript that describes the construction and application of the device has been produced and will be submitted for publication in the near future. Along with Steven Cooke, I conducted studies with experimental heart rate transmitters on smallmouth and largemouth bass. We also conducted some of the first investigations of cardiac output among centrarchid fishes, including smallmouth bass, largemouth bass, bluegill, pumpkinseed, black crappie and rock bass. Concurrent with these studies, we also executed a series of experiments designed to illuminate the effects of silt on cardiac output of riverine and lacustrine rock bass (results presented at the Canadian Conference for Freshwater Fisheries Research in Toronto in January 2001). These experiments were conducted at the Queens University Biological Station and at a research facility on the Grand River, Ontario. In August, I presented a paper at the 130th American Fisheries Society Conference in St. Louis, Missouri. The title of the paper was Mobility of smallmouth bass related to derby displacement and seasonal habitat use, and it will be published as a special publication of the American Fisheries Society as part of the Black Bass 2000 symposium.

**Publications:**

Cooke, S.J., C.M. Bunt, J.F. Schreer and D. Whal. 2001. Comparison of several techniques for the detection of movement in smallmouth bass. *Journal of Fish Biology*. In Press

Cooke, S.J. and C.M. Bunt. 2001. Behavioural and physiological assessment of internal and external antenna configurations for transmitters implanted in smallmouth bass (*Micropterus dolomieu*). North American Journal of Fisheries Management. In Press.

### **Long-term monitoring of Largemouth and Smallmouth Bass Reproductive Success**

The long-term monitoring of during the reproductive season can give insight to a number of questions, including habitat use, site fidelity, recruitment questions based on reproductive success and year to year variation in mating and reproductive success. To address these questions in largemouth and smallmouth bass, we have been monitoring the reproductive activities of those species at several sites within Lake Opinicon, including four islands and two km of shoreline. These habitats have been annually monitored during the spawning period by visual swims using a mask and snorkel. Data collected included the location of the nest, depth, assessment of mating success, size of parental male, and duration of parental care for each male, as well as the occurrence of hook-wounds from angling.

**Assistants:** Julie Claussen, Cory Suski, Jana Svec, Jim Ludden, Matt Coombs, Katie Deters

#### **Jana Svec - Reproductive ecology of Smallmouth Bass - M.Sc thesis, U of Illinois**

Currently there is some debate among fisheries biologists whether or not smallmouth bass recruitment is influenced by population-level reproductive success. To address that question, the reproductive success of individual nesting male smallmouth bass has been followed in a portion of the Mississippi River, southeastern Ontario, Canada as part of a long-term study. Data so far have shown a positive correlation between the number of smallmouth bass fry produced in a year (reproductive success) and the strength of that resulting year class one and two years later (recruitment). Smallmouth bass have also shown a high incidence of nest-site fidelity in the Mississippi River, with many males returning to the exact same nest site year after year. Understanding the underlying mechanisms influencing various aspects of the reproductive ecology of smallmouth bass may lead to better management and conservation of the species.

**Assistants:** Jim Ludden, Cory Suski, Matthew Combs, Kate Deters

#### **Cory Suski - A Linking reproduction to conservation efforts for the largemouth bass and smallmouth bass@ - M.Sc. thesis, U of Illinois**

A productive bass fishery can attract large numbers of non-resident anglers and can be a major economic benefit for that local area. As part of a long-term research project, the movements, site fidelity, reproductive success and nesting characteristics of largemouth bass were studied in an attempt to determine how biotic and abiotic factors combine to influence their reproductive success and their angling vulnerability. In addition, experiments were performed that showed that brood loss to predation, which occurs while a male is absent from his nest, is the primary reason for nest abandonment in nesting bass following a catch-and-release angling event. The results of these studies can be used to direct the placement and development of voluntary bass sanctuaries as an alternative management tool that can be used to protect nesting bass.

**Assistants:** Matthew Combs, Jim Ludden, Frank Phelan, and Jana Svec

### **AConservation Zones as Management Tools@**

Current regulations in Ontario prohibit angling for nesting bass while they are spawning and guarding their young. Existing regulations, however, permit angling for other game fish such as northern pike. As a result, it is possible to inadvertently hook a nesting male bass while legally angling for northern pike. Catching and releasing male bass can lead to an increase in their nest abandonment, and a concomitant decline in reproductive success within a waterbody. Over time this can affect not only bass population size structure, and but also the quality of a bass fishery within a lake. One alternative management strategy that may prove effective at preventing the inadvertent angling of male bass is a peer-enforced, voluntary bass conservation zone. This conservation zone, when properly enforced, can reduce harmful angling levels, and can lead to an increase in nesting success. Current research to assess the efficacy of those programs is being conducted on six nearby lakes (Loughborough, Bob=s, Sand, Devil, Buck, and Wolfe) and is attempting to design a protocol that uses littoral zone characters, shoreline features, and topographical maps to predict areas preferred by nesting bass. Once developed, this protocol would allow lake associations and local residents to establish bass conservation zones using readily available and easily recognizable cues.

**Assistants:** Julie Claussen, Dr. John Epifanio, Jim Ludden, Cory Suski, Matt Coombs, and Jana Svec

**Dr. Frances R. Pick** - Department of Biology, University of Ottawa, Ottawa, Ontario

### **Brigitte Lavallée - Abundance of picocyanobacteria in lakes as a function of total phosphorus concentration: the importance of growth and grazing - M.Sc. thesis**

Picocyanobacteria (PC) are blue-green algae smaller than 2 μm in size. They are found in every lake and can reach an abundance up to 106 ml<sup>-1</sup>. The small size and specialised pigments of PC make them able to compete in low nutrient and low light systems. But since phosphorus is generally the limiting nutrient for algal growth, scarcity of this nutrient and the impact of grazing by protozoans can limit PC abundance. The goal of this study is to verify if the amount of total phosphorus (TP) in lakes can predict the abundance of PC and to measure the grazing pressure on PC.

Fifty lakes of various TP concentration were sample in Québec and Ontario during the summer 2000. From July 24th to 27th, water samples were taken at Big Rideau, Indian, Opinicon, Otter, Upper Rideau, Upper Rock, Westport Sand and Wolfe lakes. Grazing pressure was measured by 24 hour incubation experiments where an inhibitor of PC growth was added to the lake water sample; PC abundance was determined by epifluorescence microscopy.

**Assistant:** Marianne Simonyi-Poirier



**Dr. Paul Sherman** - Department of Neurobiology and Behavior, Cornell University, Ithaca, NY

**Dr. Bryan Neff - Parentage and parental investment decision in bluegill sunfish -  
NSERC Postdoctoral Fellow**

Theory of parental care evolution predicts that genetic relatedness to young will affect the amount of care parents provide, assuming that parents can somehow assess kinship. Empirical data, however, have been contradictory, leading some to doubt the theory. To effectively test the theory, experiments that manipulate a parent's perceived relatedness to its young are required. The mating system of the bluegill sunfish provides an exception opportunity to conduct the needed experiments and accurately test parental care theory. Bluegill males are characterized by alternative reproductive life histories. Some males, referred to as parentals, delay maturation to about 7 years of age and then construct nests within social breeding colonies, court and spawn with females, and provide sole parental care for the young in their nest. Other males referred to as cuckolders mature precociously at 2 years of age, and sneak into the nests of males or use female mimicry to steal spawnings from parentals. I manipulated the perceived parentage of nesting parental males by: (i) placing small cuckolders around males nests in clear boxes to give the illusion of higher parasitism rates; or (ii) swapping a portion of a male's eggs with those from another nest (parental males can presumably assess kinship using olfactory cues in secreted urine). The parental investment was then quantified for each manipulated male and an appropriate control group. These data will be compared to determine if manipulated males provide less parental investment, as predicted by parental care theory.

**Assistant:** Peng Fu

**Publications:**

Neff, B.D. 2001. Genetic paternity analysis and breeding success in bluegill sunfish (*Lepomis macrochirus*). J. Heredity (in press).

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

**"Water Mite Parasitism of Aquatic Insects"**

**I. Systematics of *Arrenurus* spp. water mites**

In 2000 I continued study of *Arrenurus manubriator* (sensu lato): it is not clear whether 1) the species is extremely variable among populations, 2) there are two cryptically-close species, or 3) there is incipient speciation in progress, possibly of multiple origin. The one species (or subset of populations) foregoes parasitic larval feeding and is characterized by large eggs, reduced larvae, and smaller adults, of which the female has an enlarged gonopore. The other species or subset of populations retains parasitic larval feeding (typical of water mites), and has smaller eggs, normal larvae, and larger adults, of which females have a normal (small) gonopore. My goal this year was to compare adult female morphology among various populations over a broad geographic range, to test whether there was continuous variation (indicative of a single, highly variable species, or possible incipient speciation in progress) or

two distinctively-different groups (indicating two close but distinctly-different species). Past hybridization experiments between populations representing the two life histories resulted in the one F1 combination being almost entirely inviable, while the other, if anything, showed hybrid vigour. Some specimens in the present study were collected locally, many were from samples in the Canadian National Collection.

First, there is broad overlap in body size among populations, although strong statistically-significant differences among means. Populations within about 150 km of QUBS were all quite similar in size and proportions, and were typical of populations without larval parasitism (lack of larval parasitism confirmed for a number of these populations). Populations in the Black R. (N. of Highway 7, near Madoc), the Little Madewaska R., and Madewaska R. (Algonquin Park, N. and S. of Lake Sasegewun, respectively) were typical of populations with parasitic larvae (and obligatory larval parasitism has been confirmed in these populations). Ranging farther within Southern Ontario and Southern Quebec, all were typical of populations without larval parasitism until reaching into the Haliburton/Algonquin and Gaspé regions (respectively). There are clusters of populations typical of those with larval parasitism in Mississippi, Arizona, and parts of Missouri, with most of the other populations being typical of those with non-feeding larvae. The smallest average body sizes of populations representing both life histories were from the Southern States (Mississippi, Texas, Arizona) whereas the largest were northern (Ontario, Quebec, New York). These results suggest that body size reflects both clinal variation and life history differences. In overview, while there appears to be two distinctively-different groups based upon Northern populations (especially within Ontario), there is a general gradient on body size, gonopore size, and ratio of gonopore size to body size across a selection of North American populations. The best interpretation at present is that these populations represent a single highly variable species, with possible incipient speciation occurring in several different foci.

**Assistants:** Jennifer Moran, Fawn Stehlin

### **Jennifer Moran - Tabanidae (horseflies and deerflies) of the QUBS region**

Anyone who has worked at QUBS would likely tell you that while the mosquitoes and blackflies aren't too bad, the deerflies and horseflies can be awful. The preliminary goals of this study were to identify what deerfly and horsefly species are represented in the region of QUBS, to evaluate the relative importance of each as a nuisance, and to determine the seasonality of the species present. Secondary goals were to design traps based upon natural behavioural cues, and to test whether it was possible to use these traps to decrease populations of the pest species.

The spring and summer period 2000 was one of the coldest and wettest in recent memory; we are probably the only people to complain that the horse- and deerflies were not much of a problem. The first tabanid was captured in mid-May, quite a bit later in the season than what is remembered from other years. Nineteen species were encountered: 7 *Hybomitra* spp. (horseflies), 2 *Tabanus* spp. (horseflies), and 9 *Chrysops* spp. (deerflies). There was a marked seasonal progression, for example, *Chrysops excitans* was one of the earliest pest species, recorded from mid-May to late June, *Chrysops cincticornis* was bad from mid-June to early July, and *Chrysops montanus* was a nuisance from late June through July. There was also notable habitat specialization, e.g., *Chrysops aestuans* was only found in shallow, plant-choked bays such as Deadlock Bay and the Northeast Sanctuary, where it represented more than 95% of all tabanids encountered. *Hybomitra lasiothalma* and *Hybomitra illota* were the only major pests among the horseflies, and were encountered in mid-May to late June and late May to early July,

respectively. The two *Tabanus* species were rarely encountered, but spectacular: *T. atratus* is huge and totally black (nicknamed the Stealth Bomber, or Darth Vaderfly) and the eyes of *T. quinquevittatus* are almost totally electric green. Video image capture technology was used to record the diagnostic features of these species, and to construct an atlas, which will make it easier to identify these species in future.

Unfortunately, the low numbers of tabanids and rainy weather compromised efforts to trap these flies - it was late in the season before there were sufficiently large populations for experimentation, and that trap design could be adequately tested. The secondary goals of this study will have to wait for a better deerfly year.

### **Fawn Stehlin - Habitat choice and limited co-occurrence in two species of water strider**

Previous work by BPS has documented shifts in habitat use and co-occurrence in *Gerris alacris* and *Gerris comatus*: both species occur together along shorelines in late April through mid-June, but then diverge, with *G. alacris* occurring primarily in floating vegetation (e.g., water lilies) and *G. comatus* moving offshore to where beds of submerged vegetation break the surface (e.g., European Milfoil). The purpose of this study was to verify these previous results and to test these species for habitat choice in an experimental arena.

The same phenomenon of shift and divergence in habitat use was again seen, but a bit later in the season, and the shift was gradual, taking until early July to be established. It is probable that the cool, wet season resulted in longer generation times and slower population growth, hence the later shift in habitat use in spring/summer 2000. These results also suggest that crowding resulting from population growth plays an instrumental role in this shift.

Habitat choice was tested using a 2 meter X 2 meter arena, divided into 4 quadrants, one with floating vegetation (lilies), one with submerged vegetation (milfoil), with these two being separated by two open water quadrants. Position of these habitats were rotated on sequential trails, controlling for position effects. Water striders were released into the centre of the arena and their locations among quadrants were recorded after 15 minutes. Trials were conducted with a) 20 *G. comatus* alone, b) 20 *G. alacris* alone, and c) 20 *G. comatus* and 20 *G. alacris* together.

The hypotheses were that either 1) each of these two species will show a preference for their appropriate habitat type regardless of being tested alone or together, indicating a probable evolved preference and/or specialization for microhabitat, or 2) these species would only show habitat preference when tested together, reflecting probable competition for habitat space.

When tested by themselves, both species would use both floating and submerged vegetation far more often than the open water; open water is associated with a risk of predation by fish and drowning from wind and wave action. While not dramatic, both showed a slight preference for submerged vegetation over floating vegetation. When tested together, habitat choice by *G. alacris* shifted to where floating vegetation was preferred, while *G. comatus* exhibited a stronger preference for submergent vegetation. These results suggest that both types of vegetation are suitable choices for both species, but that the habitat segregation seen in summer months is a behavioural response to crowding.

**Dr. Patrick Weatherhead** - Department of Biology, Carleton University, Ottawa, Ontario; effective 1 July 2000: Department of Natural Resources and Environmental Sciences, University of Illinois

### **"Long-term studies of snakes"**

In 2000, the long-term projects on both black rat snakes and northern water snakes were maintained through the efforts of the students currently conducting thesis work of these species (see below).

#### **Laying order and sibling competition in red-winged blackbirds (*Agelaius phoeniceus*)**

Recent evidence from several species of birds suggests that females vary the amount of testosterone in eggs with laying order to influence the outcome of sibling competition in the nest. A pilot study was conducted in 1999 to assess whether laying order affecting sibling competition in red-winged blackbirds. Encouraging results from that study formed the basis for a more extensive investigation in 2000.

**Assistant:** Stephanie Doucet, Karen Cavey

#### **Gabriel Blouin-Demers - "Thermal ecology of the black rat snake (*Elaphe obsoleta*) in a cool temperate environment" - Ph.D. thesis, Carleton University**

This project was initiated in 1996 to continue the long-term ecological and demographic study of black rat snakes at QUBS and to undertake a detailed investigation of the spatial ecology and thermoregulatory behaviour of this species. Black rat snakes are at the northern limit of their range in eastern Ontario and close to the northern extreme of snake distributions. Black rat snakes thus experience high thermoregulatory costs in Ontario (cool temperatures, short active season, etc.). General models in thermal biology predict that species experiencing such high thermoregulatory costs should not invest substantial effort in thermoregulation and thus should have fluctuating body temperature profiles. Species that experience fluctuating body temperature profiles are also expected to demonstrate maximum performance under a broad range of body temperatures. These predictions have never been adequately tested using septentrional snake species. The central goal of my research is to understand the ecological factors affecting body temperature selection (foraging, reproduction, ecdysis) and how the preferences influence habitat use to gain insight into the thermoregulatory strategies of black rat snakes. I use temperature-sensitive radio-telemetry to document body temperature selection, habitat use, and movement patterns.

**Assistants:** Heather McCracken, Alissa Moenting, and Catherine Verreault (volunteer)

#### **Kelley Kissner - "Maternal influences on offspring quality in northern water snakes, *Nerodia sipedon*" - Ph.D. thesis, Carleton University**

A female's fitness is intimately related to the survival and reproductive success of her offspring. Consequently, a female may be expected to manipulate the quality of her offspring in ways that maximize her fitness. There are two general ways in which a female could influence the quality of her offspring. First, a female might control which males and/or how many males

she mates with. Second, a female might influence the quality of her offspring by varying their phenotype. I am using a combination of experimental and correlational approaches to determine the potential that exists for female northern water snakes (*Nerodia sipedon*) to influence the quality of their offspring, and the extent to which females exploit this potential to vary offspring quality adaptively to enhance their own fitness. Offspring quality is measured as overwinter survival of neonatal water snakes. Survival of neonates is monitored using individuals maintained in outdoor enclosures, complete with ponds and hibernacula, located in the Hughson tract. The field work in 2000 was limited to assessing over-winter survival of the offspring cohort from 1999, and marked the end of this phase of the project.

### **Publications:**

Blouin-Demers, G., K.J. Kissner, and P.J. Weatherhead. 2000. Plasticity in preferred body temperature of young snakes in response to temperature during development. *Copeia* 2000: 841-845.

Blouin-Demers, G., K. A. Prior and P. J. Weatherhead. 2000. Patterns of variation in spring emergence by black rat snakes (*Elaphe obsoleta obsoleta*). *Herpetologica* 56: 171-184.

Blouin-Demers, G., K.A. Prior, and P.J. Weatherhead. 2001. Comparative demography of black rat snakes (*Elaphe obsoleta*) in Ontario and Maryland. *Journal of Zoology*, in press.

Blouin-Demers, G. and P.J. Weatherhead. 2001. A novel association between a beetle and a snake: parasitism of *Elaphe obsoleta* by *Nicrophorus pustulatus*. *Ecoscience*, in press.

Blouin-Demers, G. and P.J. Weatherhead. 2001. Thermal ecology of black rat snakes (*Elaphe obsoleta*) in a thermally challenging environment. *Ecology*, in press.

Blouin-Demers, G. and P.J. Weatherhead. 2001. Habitat use by black rat snakes (*Elaphe obsoleta obsoleta*) in fragmented forests. *Ecology*, in press.

Blouin-Demers, G., P.J. Weatherhead, C.M. Shilton, C.E. Parent, and G.P. Brown. 2000. Use of inhalant anesthetics in three snake species. *Contemporary Herpetology* ISSN 1094-2246.

Brown, G. P. and P. J. Weatherhead. 1999. Factors affecting growth and sexual size dimorphism in northern water snakes (*Nerodia sipedon*). *Copeia* 1999: 723-732.

Brown, G.P. and P.J. Weatherhead. 1999. Female distribution affects mate searching and sexual selection in male northern water snakes (*Nerodia sipedon*). *Behavioral Ecology and Sociobiology* 47: 9-16.

Brown, G.P. and P.J. Weatherhead. 1999. Demography and sexual size dimorphism in northern water snakes, *Nerodia sipedon*. *Canadian Journal of Zoology* 77: 1358-1366.

Brown, G. P. and P. J. Weatherhead. 2000. Thermal ecology and sexual size dimorphism in northern water snakes, *Nerodia sipedon*. *Ecological Monographs* 70: 311-330.

Gibbs, H.L. and P. J. Weatherhead. 2001. Insights into population ecology and sexual selection in snakes through the application of DNA-based genetic markers. *Journal of Heredity*, in press.

Kissner, K.J., G. Blouin-Demers, and P.J. Weatherhead. 2001. Sexual dimorphism in malodorousness of musk secretions of snakes. *Journal of Herpetology*, in press,

Lougheed, S. C., H. L. Gibbs, K. A. Prior and P. J. Weatherhead. 1999. Hierarchical patterns of genetic population structure in black rat snakes (*Elaphe obsoleta obsoleta*) as revealed by microsatellite DNA analysis. *Evolution* 53: 1995-2001.

Lougheed S.C., H.L. Gibbs, K.A. Prior, and P.J. Weatherhead. 2001. A comparison of RAPD versus microsatellite DNA markers for assessing population structure in the eastern massasauga rattlesnake. *Journal of Heredity*, in press.

Prior, K.A., G. Blouin-Demers, and P.J. Weatherhead. 2001. Sampling biases in demographic analyses of black rat snakes. *Herpetologica*, in press.

Prosser, M. R., H. L. Gibbs and P. J. Weatherhead. 1999. Microgeographic population structure in the northern water snake, *Nerodia sipedon*, detected using microsatellite DNA loci. *Molecular Ecology* 8: 329-333

Weatherhead, P.J. 1999. Sequential mating patterns suggest extra-pair mating is not part of a mixed reproductive strategy by female red-winged blackbirds. *Proceedings of the Royal Society of London B* 266: 1027-1031.

Weatherhead, P. J., G. P. Brown, M. R. Prosser and K. J. Kissner. 1999. Factors affecting neonate size variation in northern water snakes, *Nerodia sipedon*. *Journal of Herpetology* 33: 577-589.

Weatherhead, P. J. and K. W. Dufour. 2000. Fledging success as an index of recruitment in red-winged blackbirds. *Auk* 117: 627-633.

Weatherhead, P. J., K. W. Dufour, S. C. Loughheed and C. G. Eckert. 1999. A test of the good-genes-as-heterozygosity hypothesis using red-winged blackbirds. *Behavioral Ecology* 10:619-625.

Weatherhead, P.J., K.A. Prior and G. Blouin-Demers. 2001. Synchronous variation and long-term trends in two black rat snake (*Elaphe o. obsoleta*) populations. *Oecologia*, in press.

Weatherhead, P.J. and S.J. Sommerer. 2001. Breeding synchrony and nest predation in red-winged blackbirds. *Ecology*, in press.

### **Theses:**

Sommerer, S.J. 2000. Offspring sex ratio variation in eastern garter snakes and eastern ribbon snakes. M.Sc. Thesis, Department of Biology, Carleton University, Ottawa, Ontario.

**Drs. Jayne E. Yack** (Department of Biology, Carleton University) and **Patrick J. Weatherhead** (Department of Biology, Carleton University and as of July 1, 2000: Department of Natural Resources and Environmental Sciences, University of Illinois)

### **Acoustic Territorial Behaviour in Caterpillars**

Caterpillars are one of earth's primary consumers of forests and crops. Their major ecological and economic importance has prompted extensive scientific investigation into their feeding habits, and relationships with host plants, predators and parasites. Only recently however, have scientists begun to focus on the importance of conspecific relationships. Many caterpillars live in semi-social conditions for at least some part of their lives, and it is becoming apparent that cooperative or agonistic interactions are crucial for survival.

Despite the importance of conspecific relationships, the means by which caterpillars communicate with one another is very poorly understood. This summer (2000) we explored the potential role that acoustic signals play in communication for a local hook tip moth larva, *Drepana arcuata* (Lepidoptera: Drepanoidea). We have shown, through experimental investigation and natural history observations, that larvae employ a complex combination of drumming and stridulatory signals while aggressively defending leaf nest sites from invading conspecifics. Our studies provide the first strong evidence for the use of acoustic signals for conspecific communication in caterpillars.

**Assistant:** Megan Whitehead, summer NSERC student

*Summary of Conference, Meeting and Field Trip Use of QUBS in 2000*

Organizer	Function	Number of Participants	Duration
Dr. Raleigh Robertson (Queen's - Biology)	Bio 526 (Mating Systems) Field Trip	10	April 11
Neal Michelutti (Queen's - Biology)	Lake Ecology High School Enrichment Field Trip	27	May 10
Neal Michelutti (Queen's - Biology)	Lake Ecology High School Enrichment Field Trip	27	May 17
Mike Runtz (Carleton - Biology)	Taverner Cup - Baillie Birdathon	20	May 27
Jim Atack (RVFN)	Rideau Valley Field Naturalists Field Trip	20	June 10
Julia Nicholson (Queen's - SD)	Science Discovery Field Trip	20	July 19
Julia Nicholson (Queen's - SD)	Science Discovery Field Trip	16	Aug 2
Tyler Smith (Royal Botanical Gardens)	Field Botanists of Ontario Field Trip	13	Aug 5-6
Donna Ivimey (Queen's - UACC)	University Animal Care Meeting	11	Aug 11
Dr. John Smol (Queen's - Biology)	Post- Conference` Paleolimnology Field Trip	26	Aug 26-27
Dr. Ed Kott (Wilfrid Laurier - Biology)	WLU Biology Field Course	11	Aug 27 - Sept 9
Neil Patterson (CLAHS)	Chaffey's Lock and Area Heritage Society Meeting	8	Sept 9
Jason Pither (Queen's - Biology)	Algonquin to Adirondacks Steering Committee Meeting	6	Sept 17



Organizer	Function	Number of Participants	Duration
Doug Archibald (Queen's - Geol. Sciences)	Geology 221 (Geological Field (Methods) Field Trip	40	Sept 20-21
Dr. Lonnie Aarssen (Queen's - Biology)	Biology 302 (General Ecology) Field Trip	70	Sept 23-24
Dr. Lonnie Aarssen (Queen's - Biology)	Biology 302 (General Ecology) Field Trip	64	Sept 30- Oct 1
Andrew Stevens (Queen's - Biology)	Queen's Outdoor Club Canoe Field Trip	12	Sept 30-
Dr. John Smol (Queen's - Biology)	Biology 335 (Limnology) Field Trip	46	Sept 30
Dr. John Smol (Queen's - Biology)	Biology 335 (Limnology) Field Trip	39	Oct 1
Dr. Ed Kott (Wilfrid Laurier - Biology)	Fish Ecology Field Trip	9	Oct 6-9
Dr. Don McQueen (York - Biology)	Ecology Field Trip	13	Oct 6-8
Dr. Jules Blais (Ottawa - Biology)	Limnology Field Trip	33	Oct 13-15
Jean Langlois (CPAWS)	Algonquin to Adirondacks Meeting	32	Oct 20-22
Brenda Saunders (Queen's - Biology)	Queen's Outing Club Field Trip	10	Oct 28
Michael Harrison (Robert Hopkins P.S.)	Fish Ecology Field Trip	8	Nov 2
Nicki Sharma (Queen's - QPID)	Queen's Program in International Development Workshop	14	Nov 10
Anne Robertson (KFN)	Kingston Field Naturalists Field Trip	14	Nov 21

*Seminars 2000*

Seminars marked by asterisks (\*\*) were arranged as open seminars as part the QUBS outreach program in conjunction with the Friends of Opinicon

Sunday, May 7

Scott Tarof, PhD candidate (Biology – Queen’s U.) - Clustering behaviour in Least Flycatchers: Season snapshot

Monday, May 8

Javier Salgado-Ortiz, PhD candidate (Biology – Queen’s U.) - Slash and burn disturbance and patterns of avian diversity at the Calakmul Biosphere Reserve, Campeche, Mexico: The conservation implications of a habitat mosaic

Tuesday, May 9

Dan Mennill, PhD candidate (Biology – Queen’s U.) - Interactive playback and study of female eavesdropping in Black-Capped chickadees

Wednesday, May 10

Dr. Allen Keast - Professor Emeritus (Biology – Queen’s U.) - Evolution of Australian Avifauna

Thursday, May 11

Scott Tarof, PhD candidate (Biology – Queen’s U.) - Mating behaviour in Least Flycatchers: Success amidst adversity

Wednesday, May 17 \*\*

Michael Runtz (Biology - Carleton U.) - Beaver ponds : Oases of life

Tuesday, June 13

Sophie Sommerer, Msc candidate (Biology - Carleton U.) - Litter sex ratios and offspring size in garter and ribbon snakes

Wednesday, June 14\*\*

Dr. Gray Merriam - Professor Emeritus (Biology - Carleton U.) - Action in Subnivea: What do cold-blooded things do in winter?

Monday, June 19

Mike Kasumovic (Biology – Queen’s U.) - Good-bye and thanks for all the parental care: Cowbird offspring sex ratio

Monday, June 26

David McRuer (Biology - Carleton U.) - Parasites and frog populations

Seminars (cont’d)

Monday, July 17

Dean Fitzgerald, PhD candidate (Biological Sciences - U. of Windsor) - Ecology of Yellow Perch in temperate lakes of North America

Wednesday, July 19

Dr. Tom Sherratt (Biology - U. of Durham, U.K.) - Synchrony and traveling waves in the population dynamics of the field vole in Northern England

Monday, July 24\*\*

Dr. Francis Cook (Curator of Herpetology (retired) - National Museum of Canada) - Amphibians and reptiles in Eastern Ontario: Identification and life histories

Monday, July 31\*\*

Brian Campbell, PhD candidate (Forestry - U. of Toronto) - Biodiversity, ecology and conservation of boreal mixed-wood songbird communities in a managed forest landscape

Monday, August 7\*\*

Dr. Laird Shutt (National Wildlife Research Centre - Canadian Wildlife Service) - Bald Eagles of the Lower Great Lakes: Their decline and recent recovery

Thursday, August 10\*\*

Turid Forsyth - From Kew to Hong Kong: Botanical gardens of Colonial times

Monday, August 14\*\*

Dr. Paul Aird - Professor Emeritus (Botany - U. of Toronto) - Conservation in a developing nation: The Canadian experience

Monday, August 21\*\*

Dr. Al Gorman - Professor Emeritus (Geological Sciences – Queen's U.) - The geologic History of the Opinicon area

***Documentation of Use of QUBS in 2000 - User-Days***

User	Supervisor	Post-Doc	Graduate	Assistant	TOTAL
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			Student		
<b>INTERNAL (QUEEN'S) RESEARCH</b>					
Aarsen	6	0	11	10	27
Boag	0	0	1	0	1
Eckert	4	0	0	120	124
Harmsen	3	3	0	3	9
Hodson	0	0	10	0	10
Karagatzides	0	0	5	2	7
Keast	78	0	0	0	78
Kyser	0	0	0	2	2
Leggett	0	5	2	2	9
Montgomerie	5	0	0	47	52
Ratcliffe	8	0	242	303	553
Robertson	59	0	261	556	876
Smol	1	0	3	5	9
Tufts	0	0	8	9	17
<b>Total Internal</b>	<b>164</b>	<b>8</b>	<b>543</b>	<b>1059</b>	<b>1774</b>
<b>EXTERNAL RESEARCH</b>					
<b>University of Toronto</b>					
Baker	0	0	119	86	205
Barrett	0	0	7	0	7
Fullard	71	0	0	225	296
Gross	2	0	30	4	36
Gwynne	0	0	17	2	19
<b>Carleton University</b>					
Forbes	27	0	129	82	238
Weatherhead	53	0	79	298	430
Yack	1	0	0	61	62
<b>Illinois Natural History Survey</b>					
Philipp	63	49	173	240	525
<b>University of Oslo - Zool. Museum</b>					
Lifjeld	4	0	0	0	4
<b>Virginia Commonwealth U.</b>					
Epifanio	19	0	0	0	19
<b>Ithaca College</b>					
Smith	85	0	0	142	227
<b>Trent University</b>					
Fox	3	0	3	0	6
<b>Cornell University</b>					
Sherman	0	42	0	0	42
<b>Agriculture Canada</b>					
Smith	2	0	0	3	5
<b>University of Ottawa</b>					
Pick	0	0	4	4	8

*Documentation of Use of QUBS in 2000 - User-Days (continued)*

User	Supervisor	Post-Doc	Graduate Student	Assistant	TOTAL
<b>Total External</b>	<b>330</b>	<b>91</b>	<b>561</b>	<b>1147</b>	<b>2129</b>
<b>Total Research User-Days</b>	<b>494</b>	<b>99</b>	<b>1104</b>	<b>2206</b>	<b>3903</b>
% Queen's	33.2	8.0	49.2	48.0	45.5
% Non - Queen's	66.8	92.0	50.8	52.0	54.5

**USER-DAYS IN TEACHING ACTIVITIES                      1912**

**CONFERENCE AND FIELD TRIP USE                      424**

**OTHER\*    1745**

**GRAND TOTAL USER-DAYS IN 2000\*                      7984\*\***

(\* QUBS staff, family and their visitors are not included, nor are construction workers involved in the demolition and rebuilding of the central building)

(\*\* down 10% from 1999)

*Fee Schedule for 2001*

### University Research and Teaching Rates

#### Board Charges - Meals only

\$500/month/person	-no obligation for chores
\$350/month/person	-includes obligation for chores on a rotating schedule

#### Accommodation Charges - Housing only - no linen service

\$36/month/person	-dormitory (White House or Curran Cottage)
\$72/month	-small cabin (Cabins 1, 4, 5, 6, 7, 11)
\$144/ month	-medium cabin (Cabins 2, 3, 8, 9, 10, 13, 14)
\$190/month	-large cabin (Cabins 12, 15 and White House Apartment)
\$270/month	-Cottage (Keast, Earl, Sumac or Maplewood)

#### Room and Board Rates for Short-term Users - no linen service

\$235/person	-weekly R&B for field courses - includes a lab fee
\$30/day/person	-24 hr. room and board
\$5.00	-breakfast or lunch only
\$10.00	-dinner only
\$15/person	-overnight accommodation

#### Bench Fees

##### Basic\* 1 (MFA co-applicants)

\$1.00/day	principal investigator/graduate student/lab coordinator
\$0.50/day	assistant

##### Special Requirements\*\* 1 (MFA co-applicants)

\$2.50/day	principal investigator/graduate student/lab coordinator
\$1.00/day	assistant

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

\$2.50/day	principal investigator/graduate student/lab coordinator
\$1.00/day	assistant

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

\$5.00/day	principal investigator/graduate student/lab coordinator
\$2.50/day	assistant

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

\$5.00/day	principal investigator/graduate student/lab coordinator
\$2.50/day	assistant

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

\$10.00/day	principal investigator/graduate student/lab coordinator
\$5.00/day	assistant

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

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

***Fee Schedule for 2001 (continued)***

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

Boat Rental

\$250/month, \$110/week - includes maintenance from normal use - gas and oil not included

\$50/day - includes gas and oil for one day rental

By September 2002, 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**

\$3.00/person/day facility day use fee - no meals

\$45.00/person/day 24 hr R&B and day use - summer season (April 30 - September 10)

\$10.00/person/day linen service

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 oil used in boats, to photocopies and Fax.

Goods and Services Tax

G.S.T. is applicable to 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.