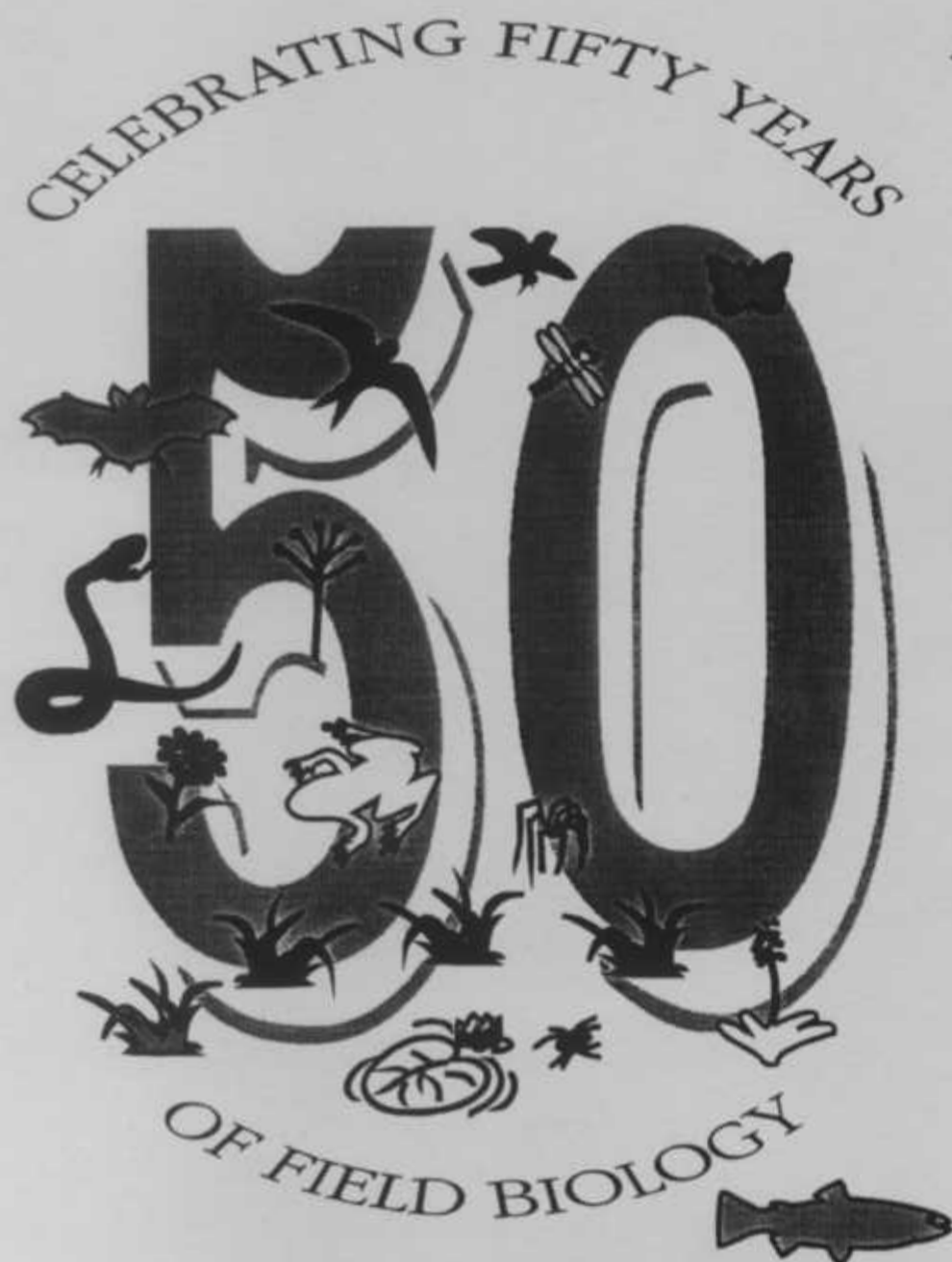


# *Queen's University Biological Station*

## *Annual Report and Newsletter*

1995



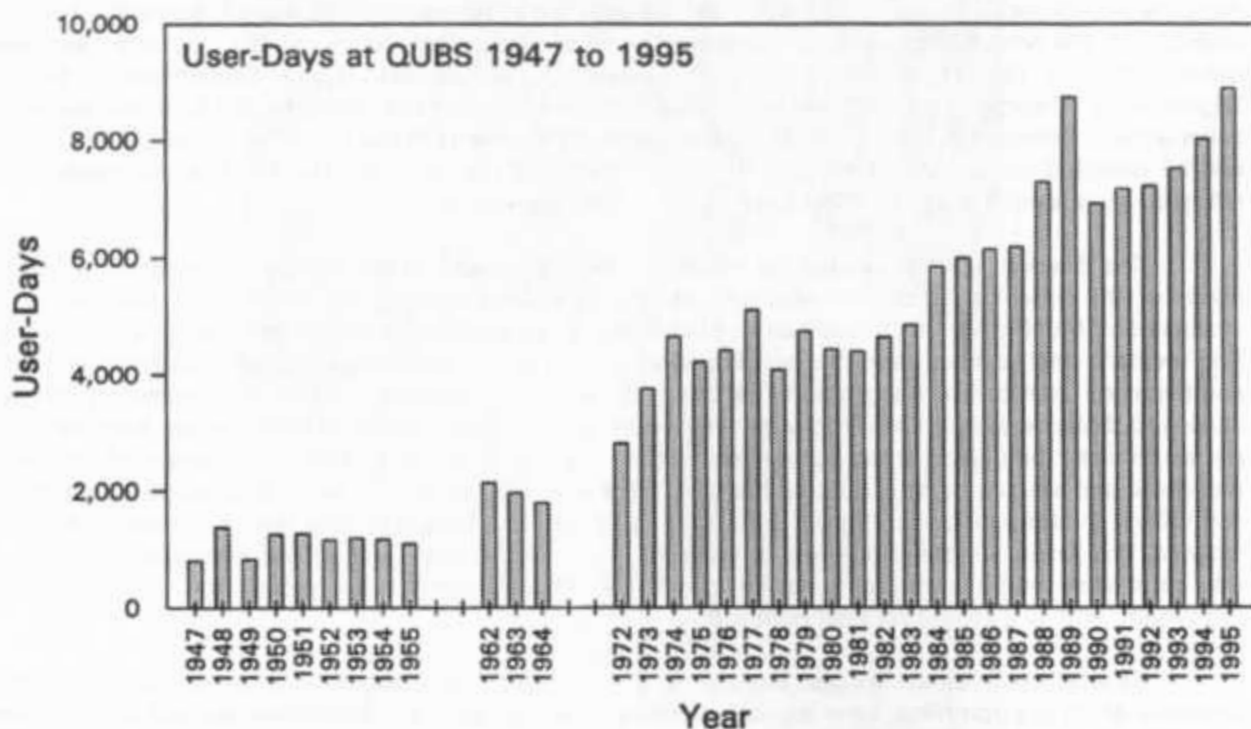
*Director: Dr. Raleigh J. Robertson*

*Manager: Frank J.S. Phelan*

## Introduction

1995 marks the fiftieth anniversary of the founding of Queen's University Biological Station. The property on Queen's Point was purchased in 1945 from the Acton family. The prime mover behind the establishment of a field station was Principal Robert C. Wallace, aided by Dr. Rollo Earl (Chair, Department of Biology) and Dr. Wes Curran (Founding Director, QUBS). In 1995 we did not celebrate this event because attention is focussed on 1996 as the celebratory year of 50 years of operation as a field station. Several events are in the planning stages for 1996, aimed at QUBS alumni, neighbours and friends and current regulars. Plan to join in the celebration!

Nineteen ninety-five was the busiest year yet at Queen's University Biological Station. The year was highlighted by the dedication of the Bracken Tract, which was donated by George and Margaret Bracken. It was a productive year for both research and teaching, with a ten percent increase in user days from 1994 levels (User-day data are displayed in tabular form later in this report). On average, 36 researchers (professors, graduate students, honours students and assistants) were in residence throughout the summer. Abstracts of research projects and personnel involved are contained in the following pages.



In teaching activities, QUBS hosted ten modules in the Ontario Universities Program in Field Biology. Seven of these were presented by Queen's faculty, three by faculty from other institutions. Titles and enrolments for modules held at QUBS and for the OUPFB program in general are found in Tables 1 through 3. In addition to the modules mentioned above, Dr. Ed Kott (Wilfrid Laurier University) brought his field course for senior undergraduates to QUBS for two weeks in late summer. In spring and fall, Steve Thompson (Sir Sandford Fleming) brought his Terrain and Water Resources Field Course to QUBS. The seventeenth edition of the Naturalists' Workshop, described in more detail later in this report, was held in three sessions, one mid-May, and two in July.

The demand for small conferences, meetings and workshops continues to grow. However, QUBS is able to host these events only when not in conflict with teaching and research uses. This year, given the high levels of use, only a few of these events were hosted in 1995. QUBS continues to be an important destination for a variety of field trips, especially those associated with fall and winter term courses. In many cases, this exposure to field work is cited as a key element in stimulating interest in field biology. A tabular summary of conference, meeting and field trip use of QUBS in 1995 appears later in this report.

### Donation of Bracken Tract

This 500 acre tract was donated to Queen's University by George and Margaret Bracken in 1994. George is a surveyor from Smith's Falls and an alumnus of Queen's. The property was donated in memory of his parents, George N. Bracken and Lena B. Bracken (nee Pierce). On March 31, 1995, a ceremony recognizing the donation took place at the University Club. All five of George and Margaret's children were able to attend, no mean feat since that encompassed Vancouver, British Columbia to Bristol, England.

Appreciation for the gift was expressed on behalf of Queen's by Dr. David Turpin (Vice-Principal (Academic)), Dr. Gerry Morris (Chair, Department of Biology), Dr. Raleigh Robertson (Director, QUBS), Dr. Herwart Helmstaedt (Chair, Department of Geological Sciences), Dr. Victoria Remenda (Asst. Professor, Department of Geological Sciences), Dr. Will Bawden (Chair, Department of Mining Engineering). George Bracken then spoke, outlining the history of the property and how the donation came about. Principal William Leggett then assisted the Brackens in the unveiling of the plaque which will be installed on a rock monument at the entrance of the Bracken Tract. The ceremony was followed by a luncheon in the West Lake Room of the University Club.

The Bracken tract is located on Newboro Lake, just west of the village of Newboro. About two-thirds of the Bracken Tract (northern and eastern portions) is open old field in various stages of succession. Much of the field area has not been regularly hayed but provides grazing for a few cattle. The western and southern portions are occupied by forest of varying age, density and quality. The south-central portion of the property is covered by moderately old forest, dominated by maple, ironwood, basswood and ash. In places, the forest cover is thick, with old trees, some massive. On the south side, the upland areas slowly descend toward Newboro Lake. There is a variety of rich, wet woodland and swampy area bordering the lake. This area includes dry woodland, lakeside forest, alder and willow thickets in low-lying pockets and fringing wet shrublands replete with a diversity of ferns, mosses, and forbs. At the lake edge, a ribbon of cattail marsh and expanses of emergent plants give way to shallow embayments of waterlily, pondweed and submergent aquatic plants. The foreshore lies wholly within a Provincial Fish Sanctuary.

Several small islands are also included in the property. Of geological and historic interest is the presence of an old iron mine, now partially flooded. The remains of a drill house are still visible, with many drill cores scattered around it. Considerable interest has been expressed in the property by hydrogeologists and geologists at Queen's. This generous gift by the Brackens should foster greater interaction between the Departments of Biology and Geological Sciences at Queen's.

In summer, a large granitic rock found on the property was moved, with the help of Maurice Hutchings and his son, and positioned to serve as a base for the plaque commemorating the Bracken Tract. This brass plaque was mounted on the monument rock, facing the eastern gate entrance (off the Mon O'Kel Road) to the property.

The inscription reads:

Queen's University pays tribute to  
George W. Bracken (BSc '56, PEng, O.L.S.)

and Margaret A. Bracken

for their generous gift of property known as the Bracken Tract

given in memory of

the late George N. Bracken

and Lena B. (Pierce) Bracken

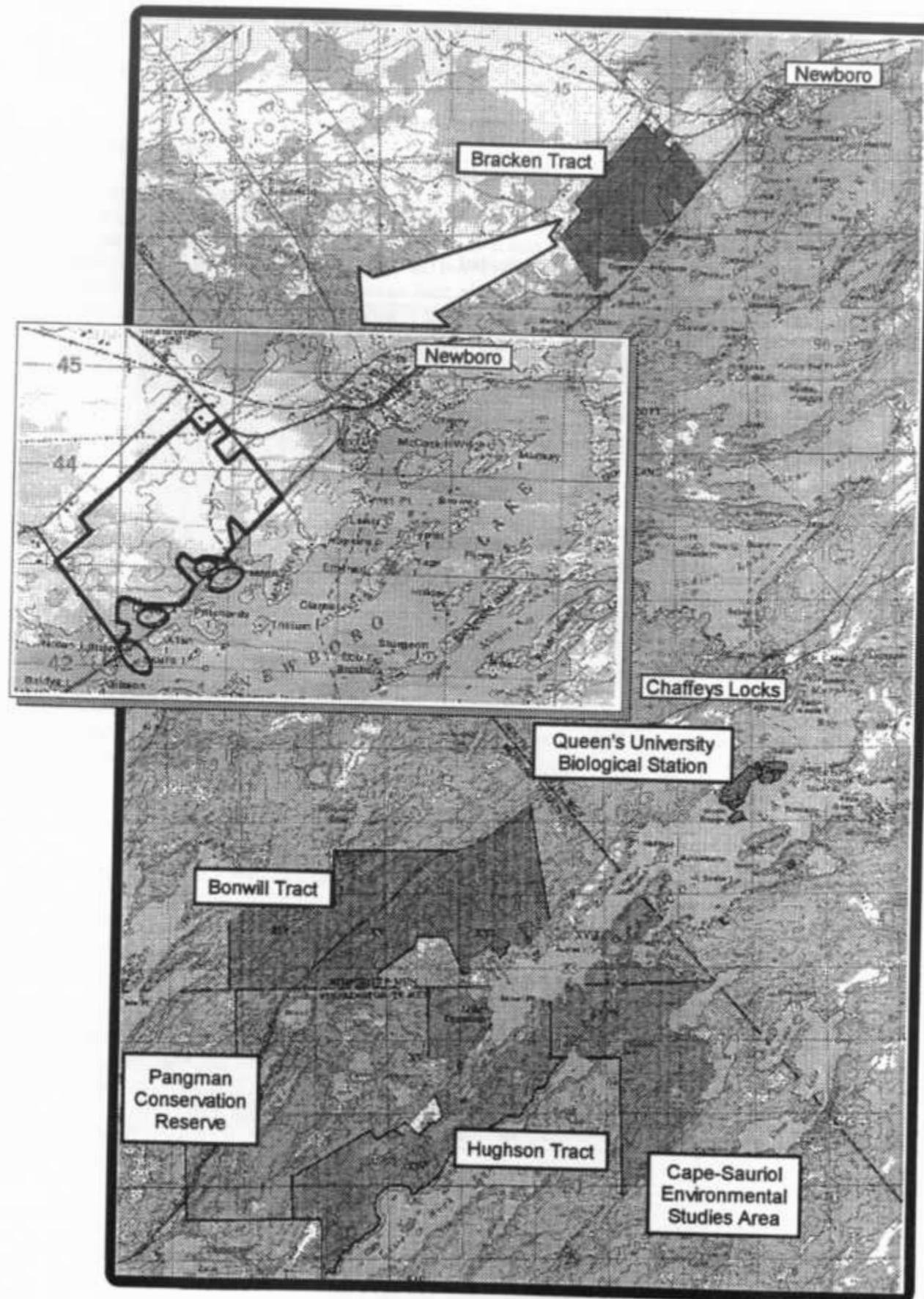
dedicated 31 March 1995



George Bracken at monument, summer 1995



# Map of Queen's University Biological Station Showing Location of the Bracken Tract



## A Farewell Tribute to Charles Sauriol - by Raleigh J. Robertson

With the death of Charles Sauriol on December 16, 1995, we at QUBS have lost a dedicated and energetic friend. Mr. Sauriol died suddenly, while at work on still another project, at the age of 91. Charles was, above all, a committed conservationist, with a passion for raising funds to preserve natural habitats for conservation, to ensure that essential elements of our nature heritage are saved for future generations.

Mr. Sauriol first became involved with projects at Queen's when, on December 31, 1984 I wrote to him to request his help in raising funds to acquire the Bonwill Tract. Charles, who at the time was Special Advisor to the Nature Conservancy of Canada, responded to my letter with enthusiasm. He knew of the Bonwill property through earlier discussions about the Skycroft land which involved the Bonwills, The Nature Conservancy and the Cataraqui Region Conservation Authority. Convinced by the merits of Queen's owning the land for a combination of educational and research purposes, Charles was instrumental in persuading the Authority to support the acquisition of the land by Queen's. Furthermore, Charles committed the Nature Conservancy to providing \$12,500, one-fourth of the cost of the purchase. He developed a "brief", in his typical fashion, and set about matching this project with donors whose objectives could be achieved by making a contribution. Through his office in the Nature Conservancy, Charles obtained donations from Mr. and Mrs. Pangman, and from Suncor, to assist with this important acquisition.

Charles became even more extensively involved in raising funds for acquisition of "The Wright Property." At the occasion of the dedication of the Bonwill Tract, in 1986, Charles and I had the good fortune to meet Henry Wright, who had already approached Queen's about the possibility of transferring some 1000 acres of the old Wright homestead to the Station. Charles knew Henry from an earlier project at Glen Major. Charles was quick to recognize the value of the Wright property, both for the Station and for conservation. He took an immediate interest in this project and expressed a willingness to help. Once agreement had been reached with the vendors on a purchase price of \$300,000, Charles committed to raising one-third of this amount. By this time Charles was no longer working with the Nature Conservancy, but rather was working on his own, to raise funds for conservation projects that he believed in. Ultimately, Charles received donations of \$50,000 from Mrs. John B. Pangman, \$12,500 each from Mrs. Dorothy Bullen and Mrs. Betty Burton, and \$25,000 from the McLean Foundation. He was also instrumental in ensuring that requests made directly by me to the Canadian National Sportsmens Shows, and to the Ontario Heritage Foundation were successful in obtaining awards of \$50,000 each. These funds, coupled with a generous donation of \$100,000 to Queen's, from Mr. John M. Cape, to help Queen's "do something for the environment", enabled the University to purchase this magnificent land with its extensive shoreline on Opinicon and Hart Lakes. This tract, which was named the "John M. Cape - Charles Sauriol Environmental Studies Area", was dedicated at a ceremony at QUBS on June 25, 1990.

Working together with Charles on these two projects, which proved to be so successful, was a very satisfying and inspiring experience. So, it was with great anticipation that we set out, beginning in August 1993, to obtain funding for "The Back Lakes - A Conservation Reserve for Warblers and Wetlands, Science and Education." I had initially felt the scope of this project, namely \$540,000, was out-of-reach. However, the youthful persuasiveness and enthusiasm about the need to acquire this land by Queen's student Paul Martin, and the similar level of enthusiasm and optimism from someone 70 years his senior, Charles Sauriol, convinced me that at least we had to try. Once again, Charles enthusiastically endorsed our proposal, and helped develop a "brief" which very effectively conveyed the value and importance of this tract of 1500 acres of forest and wetland. Charles further assisted by suggesting people whom he knew, through his many years of working with them on various land-acquisition projects, would be interested in helping. One of these people was Mrs. Hilda Pangman who, along with her husband John, had contributed to many projects in which Charles had been involved. Fortunately for us all, Mrs. Pangman donated the entire amount needed



to acquire the Back Lakes tract as a memorial to her husband who, like herself, had a strong appreciation of nature. The "Hilda and John B. Pangman Conservation Reserve" was dedicated at QUBS on July 15, 1994. At the dedication, Charles Sauriol, now in his 91st year, took great pride in addressing the group, expressing his gratitude to Mrs. Pangman, and championing the cause of conservation for the benefit of future generations.

Charles Sauriol had a remarkable life. He was passionate in his efforts to secure natural areas for conservation purposes. He was truly an inspiring person. It is somehow difficult to grasp the fact that he had a full and successful career as an advertising executive, through the age of 50, and that his career as a conservationist was not launched until he was well into his 50's. I did not meet Charles until he was nearly 80 years old, and all that he accomplished for Queen's and conservation in the Lake Opinicon area was done since that time!

Charles had grown up in Toronto, and his experiences as a Boy Scout, camping along the Don River, made a deep impression on him. He loved the out-of-doors, and through his career had been concerned with preserving the Don Valley. However, much of his effort had been to no avail until the devastating floods of Hurricane Hazel, in 1954, made it obvious that the flood plains of the Don were inappropriate for development. Beginning in 1957, at the age of 53, Charles was appointed to the board of the Metro Toronto Region Conservation Authority. From 1966 through 1987 he worked with the Nature Conservancy of Canada. And, from 1987 until the day he died, he worked independently, as his chartreuse stationery boldly stated - "Charles Sauriol, Conservationist" - with energy, dedication and effectiveness to raise funds to preserve natural area land. It is sad to lose such a cherished friend, to know there will be no more cups of coffee and planning sessions, no more optimistic chats on the phone. Yet, at the same time, realizing that it was such a privilege and a source of inspiration to work with Charles, and knowing that what he helped accomplish for Queen's and for conservation will last for generations to come, should be a source of great motivation for us all.

## Pangman Commemorative Plaque

Only a few meters inside the gate, along the Lindsay Lake Road, a monument rock was brought in and erected to serve as a base for a brass plaque marking the Pangman Conservation Reserve. A mock-up of the plaque had been unveiled by Mrs. Hilda Pangman at the dedication of the Reserve, last year. The inscription reads:

Hilda and John B. Pangman Conservation Reserve  
This conservation area is given to Queen's University for ecological studies,  
and the teaching of young Canadians  
the care and love of our nature heritage

dedicated 15th of July 1994.

This monument will stand as a recognition of the generous gift from Mrs. Pangman

## Moore's Donation

As 1995 wound down, Ian Fraser (Director, Office of Advancement at Queen's) was contacted by Frank and Beth Moores about a potential donation of land to the Biological Station. Frank was, at one time, Premier of Newfoundland. Currently, the Moores have a home on Indian Lake, close to the field station. The Moores had, for some time, contemplated donating some 200 acres of property to the university. This property has waterfront on Benson Lake and road frontage on the Indian Lake Road. Time was of the essence, requiring fast action to anchor the donation in 1995.

Right: Charles with John Heney (Queen's Director of Development), and Peter and Ann Pangman at the dedication of the Pangman Reserve - 1994



Above: Raleigh Robertson thanks Charles for his assistance at the dedication of the Bonwill Tract - 1986



Right: Charles Sauriol at the dedication of the Cape-Sauriol Environmental Studies Area - 1990

Frank and Kelvin Conrad (Interim Assistant Manager) took a firsthand look at the property via snowshoe just before Christmas. They prepared a preliminary evaluation of the property. Several features make the property desirable as an addition to QUBS landholding: 1) proximity to main QUBS complex - easy access by foot or by bicycle, 2) the waterfrontage enables access to another water body (Benson Lake), 3) there are well-developed pine stands along the waterfront/inlet section, 4) a large, mature marsh in the embayment off Benson Lake, and 5) the expanse of maturing old-field habitat would be a unique addition to QUBS.

Armed with this preliminary evaluation, and acting swiftly, Ian Fraser took care of the initial procedural matters toward transfer of ownership. As of this writing, the process is incomplete, but the necessary steps required to tie the potential donation to 1995 have been taken.

Thank you to the Moores for their generous gift to Queen's and QUBS.

### Plans for 50th Anniversary Celebration in 1996

In recognition of QUBS' 50 years as a field station, a number of events are being planned for 1996 to mark the golden anniversary. To publicize the celebrations, Frank wrote an article on the history of the station for the Alumni Review. Judging by the feedback from this article which appeared in the January-February issue, there is a lot of interest in events planned for the anniversary celebration. Presently, three events are being planned. The first is a symposium dealing with the impact of research at QUBS on current biological themes. This event is aimed at current and recent past users of the field station. The second event is a special Open House for the benefit of our neighbours and friends. The third event is a reunion of sorts, hoping to attract past users of QUBS back for some outings, slide shows, seminars and reacquaintance. Details are still sketchy, but keep in touch with QUBS personnel as planning continues.

### Major Facilities Access Grant

The Infrastructure program of NSERC has been discontinued. This program has, to present, been a major source of funding for QUBS, providing salary monies for assistants and for utilities etc. NSERC has replaced the Infrastructure program with a Major Facilities Access Grant program. To qualify, a facility has to be significant (provincially, nationally or internationally) and must be accessible to users from a variety of institutions. QUBS meets these requirements so Frank and Raleigh prepared an MFA submission in fall. Notification of awards should be forthcoming in March.

### Global Positioning Equipment

QUBS was successful in its application for an NSERC equipment grant in 1995. The application included a complete Global Positioning System (GPS): top-of-the-line GPS unit, software and computer. Although the award was insufficient to obtain the complete system, with a combination of funding from NSERC (\$15K), QUBS Trust Fund (\$2.5K) and the Naturalist Workshop Fund (\$2K), the GPS unit was purchased.

This unit is a Trimble Excel GPS receiver with real-time correction via radio beacon which is part of the backpack unit. This receiver enables high accuracy and comes with basic mapping software (Pathfinder). The unit was received in summer and has been used in several studies requiring spatial information. This GPS unit is the vital first step in the development of a Geographic Information System (GIS) for QUBS. A well-developed GIS system will provide a database of QUBS landholding and environs for a multitude of teaching, research, conservation and management uses.

Application for computer equipment to complete the system has recently been made to the Principal's Development Fund.

### Interim Director

During QUBS Director Raleigh Robertson's sabbatical in Australia, September through December of 1995, Dr. Chris Eckert assumed the post of Interim Director of QUBS. With the complexity of QUBS operation and affairs, it is important to have a designated member of faculty at the helm at all times.

### Interim Assistant Manager

Dr. Kelvin Conrad assumed the role of Assistant Manager of QUBS during Floyd Connor's leave of absence from November 1995 through March 1996. Kelvin's skills (especially computing) were of great assistance in maintaining and improving the facilities.

### Dr. Gordon Bennett

Dr. Gordon Bennett (Memorial University) passed away on December 24, 1995. Gordon and his wife, Lillian had spent some time at QUBS while Gordon collaborated with Dr. Pat Weatherhead (Carleton) and Dr. Bob Montgomerie (Queen's) on parasites of a range of bird species. His friends at QUBS send condolences to Lillian and the Bennett family.

### Pearl E. Williams and Llewellyn Hillis Fund

This fund has been established through the generosity of Llewellyn Hillis in memory of her parents. It is dedicated to increasing linkages between the field station, the arts and women.

In 1995, with funding from the Pearl E. Williams and Llewellyn Hillis Fund, Turid Forsyth, a local artist and photographer, offered a workshop titled "Drawing from Nature: A sketch to a finished artwork". The 13 registrants were introduced to techniques of sketching and watercolours, with emphasis on interpreting nature through art. In conjunction with this workshop, Turid offered a seminar titled "Drawing from nature: the artist's portfolio", available to all QUBS users and the Friends of Opinicon.

### Friends of Opinicon

Activities of the Friends continued in 1995, with several after-dinner nature walks and a few weekend activities. The summer was quite hot, so there wasn't much enthusiasm for lengthy outings. A highlight of the summer was Dr. James Fullard's reprise of his legendary bat lecture and flight demonstration on August 17. A large number of regulars, neighbours and friends turned out, making this a most enjoyable and successful evening. Many thanks to the Friends for organizing this event. At summer's end, Naz MacDonald again hosted the Friends' potluck supper on Hughson's Island. Many of the Friends turned out for an evening of food and conversation.

### Seminars

Raleigh and Frank organized the seminar program for 1995. This series of seminars is often a highlight of summers at QUBS. A full list of speakers and topics appears later in this report.



## Open House

The Open House was held on July 9 in 1995. We hosted about 325 visitors during the day. Despite a sprinkle of rain, turnout was very good. Feedback from visitors was very positive, everyone enjoying the tour of displays of current research topics. Thank you to all the regulars who continue to put commendable effort into making this event a success.

The 1995 version of the Community Newsletter (fourteenth edition) was distributed in early July to more than 750 households and cottages in the vicinity of Chaffey's Lock, Elgin and Perth Road Village. The newsletter keeps contact with our friends and neighbours even if they are unable to attend the Open House.

Both of these initiatives are important in maintaining close contact with the neighbouring community. It is most encouraging to see an increase in involvement in field station activities by the local community.

## Departmental Picnic

After the Open House, QUBS hosted some 38 guests who toured the displays and stayed on for a barbecue and some recreation. In attendance were members of the Department and their families. These informal opportunities offer QUBS users and staff the opportunity to get to know those in the department who do not regularly visit the station. All members of the Department are encouraged to take part in station activities whenever possible.

## 1995 Renovations and Additions

In 1995, a series of changes and improvements to QUBS facilities were undertaken. Some of these include:

1) As part of a series of improvements to Earl Cottage, the old bathroom was removed and replaced. The original bathroom was an add-on to the building, extending the roofline over the kitchen, resulting in less than six feet of headroom at the outside wall. With the old bathroom removed, the entrance step was also removed. In reconstruction, the size of the bathroom was increased to allow for a proper shower, toilet and vanity. The new roof provides another gable to the cottage, full ceiling height headroom in the bathroom and allows the main entranceway to be protected from the elements. In addition, the bathroom was rewired, replumbed, fitted with a ventilating fan, insulated and finished with gypsum board on the interior. On the exterior, rough plywood siding will be stained to match the rest of the cottage. With this renovation, only the living room remains to be improved. The bathroom work should be completed for summer of 1996.

2) In Curran Cottage, the water-damaged walls of the shower room were removed and replaced with water-resistant gypsum board. In addition, a high-velocity, through-the-wall ventilating fan was added. Hopefully this will address the excess moisture problems.

3) The stairs on the main path down to the Trilab received some attention in 1995. The railway tie steps were deteriorating, so this section was removed and replaced with concrete steps. To improve on night-time safety in negotiating these steps, a string of low-voltage footlights was installed alongside these stairs.

4) In 1995, a start was made on controlling erosion around the lodge. A curved retaining wall was constructed of interlocking blocks on the east side of the lodge (facing the Brown Lab). A large area inside this wall was filled, packed, surfaced with stone dust and graded to provide level access to the rear of the lodge and the main path past the lodge. In doing this, broad steps were required down to the Brown Lab's southernmost upper entrance. These were built with a preserved wood frame filled with earth and topped with stone dust. To provide access to the path to the Boathouse, a set of wooden steps was built down over the retaining wall. Atop the wall and lining the steps to

the Boathouse and Brown Lab, a steel safety railing was added.

5) To control erosion of the path to the Boathouse and the stairs down to the Trilab, broad steps framed with preserved wood, filled with earth and topped with stone dust were added. This stabilizes the pathways from the lodge and from the top of the stairs to the Trilab to the junction of these paths just south of the White House. Footlights were extended from the Trilab stairs to illuminate this junction. In future years, a similar treatment will be done to all pathways. This section will serve as a test of effectiveness and durability.

6) Tubular steel gates were put up at the entrance to the Lindsay Lake Road, replacing the old, ramshackle gate. In doing this, the gate was moved back from the Opinicon Road to allow more parking space. The new gateway is padlocked and robust, so should cut down on unauthorized vehicular traffic.

7) The old cabin 14 was jacked up and moved away. It was in poor condition, and in preparing to move it, it was discovered that the floor supports had completely rotted away, leaving the cabin supported only by the dirt which had been packed under the floor. In spring, the new medium-size cabin #14 was completed. Based on the new 10'x16' model, it is insulated and outfitted with a large, bright workspace. A small entrance terrace permits easy access to the cabin and a sunny patio.

8) In summer, the exterior of the Trilab was scraped and painted.

9) In spring, a new electric stove was purchased and installed in the White House. This should be a boon to fall and winter groups using the station.

10) At long last, topsoil was spread and levelled on the septic field of the Assistant Manager's House. The addition of shade-tolerant grass seed next spring should complete this work.

11) Carbon monoxide detectors were installed in the White House and Manager's House.

12) In the White House upstairs bathrooms, high-velocity ventilation fans were installed in an effort to cope with the moisture buildup associated with heavy use. At the same time, new gypsum board ceilings were installed. These ceilings will not be stippled, enabling easier cleaning and less surface area for moisture to accumulate.

13) In fall, new library shelves were added to the Curran Library. The blackboard was removed as were the shelf units on the northeast and northwest walls. Eight wooden shelving units were installed, six on the north wall and two replacing the old units on NE and NW walls. The extra space has enabled all reference material to be placed on shelves. Library holdings have been organized to make items more readily accessible. With the addition of a moveable chalkboard and a projection screen, this renovation will be complete.

14) In fall, some windstorms knocked over a few trees. One big oak fell on top of the Aquarium, crushing one roof truss and breaking up much of the roof sheathing. Repairs were effected rapidly, reinforcing the broken truss, resheathing the damaged portions of the roof and reshingling the entire building. Fortunately, Queen's insurance covered the cost of repair materials.

15) A couple of times now, barnboards have been stolen from the New Barn on the Hughson Tract. New boards have been installed to cover the gaps created by the thieves, at considerable cost and effort. It would appear that with the price of authentic barnboard, the roadside barn is vulnerable to barnboard thieves.

## The Weather Report

The electronic weather station continues to provide fundamental data on the local physical environment for QUBS users, whether for teaching purposes or for research. Various parameters are measured and recorded. Presently, temperatures are recorded for a Stevenson screen reference air temperature, three water temperatures (surface, one meter and three meters) and one soil temperature (15 cm). In addition, wind speed and direction, rainfall and solar radiation are measured and recorded. Data are recorded at five minute intervals and summaries are available in electronic format and as hard copy.

### HummerTime - Kit Muma

Floyd Connor, Peggy Latimer and I are finished our 5th year organizing the hummingbird migration monitoring project. This project relies on volunteer observers to send in reports of the arrival and departure of ruby-throated hummingbirds from their feeders in the eastern United States and Canada. In the past we have received support from the James L. Baillie Memorial Fund of the Long Point Bird Observatory. We sent our 9th newsletter to our volunteers in March 1995 with new user-friendly data sheets in a calendar format. In the newsletter we featured a report by Judy Hoy of Stevensville, MT on hypothermia in hummingbirds with a discussion of whether or not people should remove the perches on their feeders during cold weather.

In 1995, Peggy compiled a progress report and contacted potential participants in the southern U.S. to fill in the gaps in our data. We presented a map at the QUBS Open House showing the distribution of our over 300 participants. Presently, I am sorting and analyzing the data from the 1995 migration. We will be sending a newsletter to our participants in April. Our introductory letter and periodic reports are now available on the World Wide Web at: <http://www.ithaca.edu/hs/bio/bio1/hummer.htm>

### Congratulations

Dr. John Epifanio (Department of Fish and Wildlife, Michigan State University) and Jean Flemma were married on May 20, 1995 in Annapolis, Maryland. Fortunately, many of their QUBS friends were able to attend the wedding. We'll be unable to hear Mustang Sally without visualizing Epi getting down with the band. Congratulations John (Epi) and Jean!

Congratulations to Rhonda and Dale Kristensen on the birth of their son, Stuart on August 2, 1995.

Congratulations to Dr. Chris Eckert and Marlene Kraml on the birth of their son, Isaac on September 25, 1995.

### Station User Fees

After holding fast for several years, QUBS fees for 1996 will be increase by an average of 2.5%. Hopefully, this will keep use of the field station possible for a wide range of researchers, while better enabling QUBS to meet its financial requirements. The fee schedule for 1996 appears on the last page of this report.

### Theses and Publications

In an attempt to keep our listing of theses and publications emanating from work at QUBS as current as possible, please submit citations as soon as available. In addition, copies of theses should be forwarded to QUBS (we will have them bound as necessary). Reprints of publications would also be appreciated.

### Parks Canada - Rideau Canal

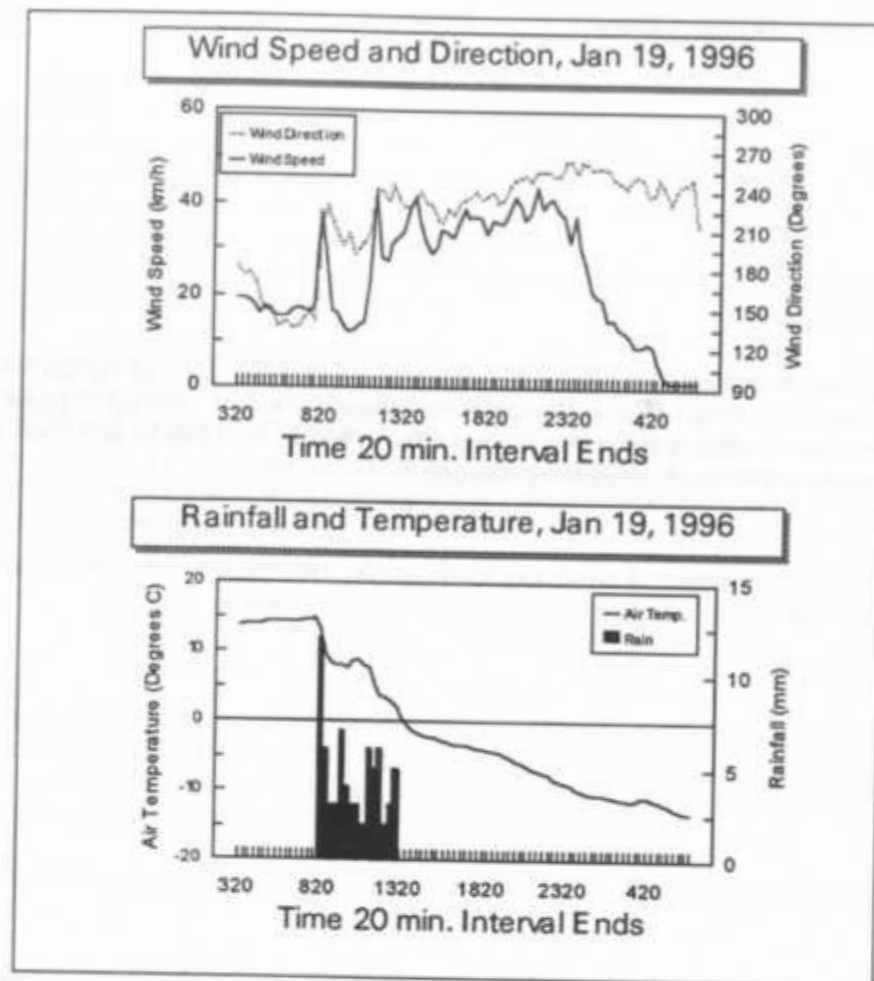
For the past several years, and again in 1995, Parks Canada - Rideau Canal, via Superintendent, Mr. John Bonser, has provided QUBS with complimentary lockage passes for both of our pontoon boats (floating classrooms). This generosity, especially in view of severe fiscal restraints, is greatly appreciated and facilitates study of a variety of water bodies along the Rideau Canal during research and teaching initiatives. All users of QUBS thank Parks Canada for their continued support.

### Acknowledgements

QUBS staff play an important, but often overlooked, role in the continued success of the field station. Thank you to Floyd Connor (Assistant Manager), Kelvin Conrad (Interim Assistant Manager), Roger (Rod) Green (Maintenance Assistant), Marg Phelan, Earl Grace and Terri Taylor (Food service Staff) and to Ron Vinkle Jr. (Part-time Assistant).

Cover: This year's cover is from the desk of Dr. Heather Proctor, in recognition of the golden anniversary of the establishment of QUBS. Thank you, Heather.





*Weather Station Activity, 1995*

The figures above illustrate the changes in wind, precipitation and temperature that occurred this year on the day of the annual station reunion. After two days of above-seasonal temperatures, a cold front moved in at about 0800. Its arrival is marked by several features on the graphs. First, the wind shifted about 80° from SW to SE and increased in speed. Temperature dropped rapidly and continued to do so throughout the day. With the shift in wind, it began to rain, and continued until the temperature dropped below 0 °C mid-afternoon, when we were treated to wet snow until dusk.

These figures typify a portion of the kind of weather information available in-house. We continue to collect (~ 1 Mb / mo!) and maintain data from our weather tower on the station point. We have archives beginning with the summer of 1992 and then more or less continuously from the spring of 1993 to the present. This year, the output for the daily summaries provided at breakfast was improved, and in the latter months of the year, we have been simplifying the existing data organization to make it more accessible and easier to use. Consider how a weather change like the one above might affect your study organism, and remember that QUBS weather data are available.

## *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

This project, intended to produce a base map and the fundamentals of a geographic information system (GIS), continued in 1995. With the acquisition of a Global Positioning System (GPS) unit capable of sub-meter accuracy and real-time correction, this work should continue apace. At present, the base map is nearing completion. This year, more of the trails and man-made features were mapped on all tracts. It is intended that more detailed information will be added to the base map over time, enabling much better knowledge of the features of all QUBS properties. The addition of information layers to a GIS housed at QUBS will facilitate a long-term database for the field station.

### Hughson Tract

In 1995, Dr. Lonnie Aarssen continued to use the New Barn enclosure plots for plant growth and competition experiments. In addition, long-term succession plots were established in the Lane Sargeant Field. Some of these plots have been freshly plowed, others will be mowed, while yet others will not be mowed. The Hughson Tract was heavily used in studies of old-growth forest, reproduction in Water Willow (*Decodon*), old-field succession, insect competition and plant growth, insect pollinators of Dogwoods, water mites, Eastern Bluebirds, Tree Swallows, damselflies, Yellow Warblers, water snakes, Pumpkinseed sunfish, Black Rat Snakes, Red-winged Blackbirds, and amphibian populations.

Haying of the open fields by Bob Butterill and David Hughson continued in 1995.

### Bonwill Tract

In 1995, the Bonwill Tract was used in studies of old-growth forests, water mites, songbirds, Cerulean Warblers, American Redstarts, Largemouth and Smallmouth Bass nesting, Ovenbirds, damselflies, amphibian populations and Black Rat Snakes.

There are established plots used by Ministry of Natural Resources personnel (Eric Boysen - Kemptville) along the Bedford Road used in long-term growth and yield studies. The data are used to compare forest regeneration rates across Ontario.

Five stations of the Canadian Wildlife Service's Forest Bird Monitoring program were sampled by Floyd Connor. This ongoing project is aimed at an understanding of population trends in forest-dwelling bird species.

Haying of the open fields was done by Bob Butterill and Dave Hughson. Mowing of the walking trails was continued by Jim Barton.

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

In 1995, the Cape-Sauriol E.S.A. was used in studies of old-growth forests, catch-and-release angling, Largemouth and Smallmouth Bass nesting, reproduction in Water Willow (*Decodon*), water mites, damselflies, Pumpkinseed and Bluegill sunfish, and amphibian populations.

Part of this tract (Joe's Point) figured importantly in the Applied Environmental Ecology field course. Various development scenarios and their local impact were studied on site. This blend of theory with hands-on field work remains the cornerstone of an effective field course teaching program.

A new walking trail from the old bridge across the Hart Lake Creek to the overlook above the portage on Hart Lake was established in 1995.

A survey of mine sites was begun in 1995.

### Hilda and John B. Pangman Conservation Reserve

In 1995, the Pangman Reserve was used in studies of old growth forest, songbirds, Cerulean Warblers, American Redstarts, Ovenbirds, Eastern Bluebirds, Largemouth Bass, damselflies, Yellow Warblers, water snakes and Black Rat Snakes.

Warner Lake was closed to fishing at the start of the year. A long-term study of the Largemouth Bass is now under way in this experimental lake. All male bass were individually marked in 1995 using passive integrated transponders (PIT tags). This lake will be used to determine details of the reproductive biology of Largemouth Bass.

In summer, a monument rock fitted with the dedication plaque was erected alongside the Lindsay Lake Road. To control vehicular access, a new gate was erected at the entrance of the Lindsay Lake Road.

### Bracken Tract

In 1995, the Bracken Tract was used in studies of hydrogeology and Eastern Bluebirds.

In summer, a monument rock was fitted with the dedication plaque in the field facing the Mon O'Kel Road entrance. Later, George Bracken and Frank spent some time revisiting the survey boundaries of the property.

In fall, with the help of Maurice Hutchings, the open fields were cut to control weed species. In addition, trees which had fallen into the fields from hedgerows were cut up and removed and encroaching woody growth was trimmed back.

Table 1: Summary of course credits in the Ontario Universities Program in Field Biology earned at Queen's University Biological Station in 1995.

MODULE TOPIC	Professor and Affiliation	Dates	Credit/Student	B	C	G	O	M	Q	To	Tr	Wa	We	Wi	Y	Total students /Module	Total 1/2 course Credits
Ecological Interactions	Harmsen (Q)	April 30 - May 6	1/4	1	0	0	0	2	4	1	0	1	1	0	1	11	5.5
Introduction to Avian Community Ecology	Lougheed (Q)	May 7 - 20	1/2	1	0	0	1	0	4	1	1	1	1	0	2	12	12
Conservation Biology	McLean (Q)	May 21 - June 3	1/2	1	1	0	1	1	3	2	1	2	1	1	1	15	15
Insect Taxonomy	Gunderman (M)	Aug. 13 - 19	1/4	2	1	0	0	0	3	1	0	2	0	0	3	12	6
Plant Sex	Shore (Y)	Aug. 13 - 19	1/4	0	0	0	0	1	3	0	0	0	1	0	5	10	5
Systematics of the Flowering Plants	Pringle (M)	Aug. 13 - 19	1/4	2	0	0	0	0	2	2	0	0	0	1	4	11	5.5
Evolutionary Ecology of Plants	Eckert (Q)	Aug. 20 - 26	1/4	0	0	0	0	0	5	1	1	0	1	1	2	11	5.5
Freshwater Invertebrate Biology	Proctor (Q)	Aug. 20 - 26	1/4	1	0	0	0	1	7	0	0	0	1	0	5	15	7.5
Systematic Ichthyology	Birt (Q)	Aug. 20 - Sept 2	1/2	0	0	0	0	1	4	0	1	2	2	0	3	13	13
Applied Environmental Ecology	Crowder et al. (Q)	Aug. 27 - Sept 2	1/4	0	0	0	1	1	5	0	0	1	1	0	3	12	6
Total Number of Student - Weeks				10	3	0	5	9	51	11	7	14	13	4	35	162	
Half - Course Equivalents				5	1.5	0	2.5	4.5	25.5	5.5	3.5	7	6.5	2	17.5		81



Table 2: Summary of course credits in the Ontario Universities Program in Field Biology earned at locations other than QUBS in 1995.

MODULE TOPIC	Professor and Affiliation	Dates	Credit/Student	B	C	G	O	M	Q	To	Tr	Wa	We	Wi	Y	Total students/Module	Total 1/2 course Credits
Tropical Field Ecology	Quinn (M)	May 2 - 18		1	0	0	0	7	2	0	2	0	0	0	0	12	12
Field Entomology	Darling (To)	May 7 - 19		1	0	0	0	0	1	0	0	0	1	0	0	3	3
Freshwater Ecology	Campbell (B)	May 7 - 13		2	0	0	1	1	1	1	0	1	0	0	2	9	4.5
Great Lakes Field Biology	Machace (Wi)	May 13 - 26		0	0	0	0	2	1	1	1	1	1	6	1	14	14
Marine Develop. Biology	Martell (C)	May 28 - June 10		0	0	0	0	1	2	0	0	0	1	0	0	4	4
Ecology of Spring Flora	Macfie (Tr)	May 14 - 26		0	1	0	0	1	3	0	5	1	2	0	3	16	16
Field Ornithology	Rising (To)	May 14 - 27		0	1	0	0	2	1	0	0	0	1	0	1	6	6
Biodiversity of Inochina	Murphy (To)	end of May		0	1	0	0	1	2	2	0	0	3	0	0	9	9
Fisheries Res. Eval. Manag.	Stephenson, Lane et al (G)	June 4 - 17		0	0	0	0	0	2	0	0	0	0	0	0	2	2
Ecot. Sump. Design. & ...	Green, Smith (We)	June 4 - 17		0	0	1	2	0	3	1	0	0	2	0	0	9	9
Ecol. & Beh. of Bats & ...	Barclay, Brigham, Fenton (Y)	June 21 - 30		0	0	0	0	0	2	2	0	0	0	0	2	6	6
Natural History	Licht (Y)	July 2 - 8		1	0	0	1	0	2	1	0	1	1	0	1	8	4
Marine Biology	Mulloch (To)	Aug 11 - 26		0	0	0	0	0	3	0	0	1	0	0	0	4	4
Field Ecology	Nadth (G)	Aug 13 - 26		0	0	0	0	2	0	2	0	1	0	0	0	5	5
Marine Biol. & Oceanography	Ballantyne (G)	Aug 19 - Sept 2		0	0	16	0	0	2	0	0	0	0	0	0	18	18
Alpine Ecology	Millar, Lavery (We)	Aug 19 - Sept 1		0	0	0	3	1	4	3	0	1	3	0	1	16	16
Aquatic Ecology	Bailey, Trick (We)	Aug 19 - Sept 2		0	0	0	0	0	2	1	0	1	5	0	0	9	9
Aquatic Microbial Ecology	Pick (O)	Aug 20 - 27		0	0	0	3	1	1	1	0	1	0	0	2	9	4.5
Bird Migration & Ecology	Francis (Q)	Aug 20 - Sept 2		0	1	0	0	1	5	0	0	2	2	0	2	13	13
Exp. Studies in Marine Biol.	Owen, Taylor (We)	Aug 25 - Sept 10		0	1	1	0	0	3	1	0	9	5	0	1	21	21
Terrestrial & Aquatic Biol.	Hawthorn, Barton (Wa)	Aug 28 - Sept 8		0	1	0	0	1	5	2	0	6	1	0	0	16	16
Ecol. of Long Point area ...	Knapton (We)	Aug 27 - Sept 2		0	0	0	2	1	3	0	1	0	0	0	2	9	4.5
Field Botany	Cameron (Y)	Aug 27 - Sept 2		0	0	0	0	0	3	0	0	0	1	0	10	14	7
Tropical Insect Biodiversity	Wood (C)	late August		1	1	0	0	0	1	0	0	0	0	2	1	6	6
Mycology	Kendrick (Wa)	Sept 2 - 16		0	1	1	0	0	0	0	0	12	0	1	0	15	15
Total Number of Student - Weeks				9	16	38	17	41	98	33	17	73	56	18	41	457	

Half - Course Equivalents

Table 3: Overall Summary of the Ontario Universities Program in Field Biology for 1995.

	B	C	G	O	M	Q	To	Tr	Wa	We	Wi	Y	TOTAL STUDENT-WEEKS IN MODULES	TOTAL HALF-COURSE CREDITS
TOTAL STUDENT-WEEKS NOT AT QUBS	9	16	38	17	41	98	33	17	73	56	18	41	457	228.5
TOTAL STUDENT-WEEKS AT QUBS	10	3	0	5	9	51	11	7	14	13	4	35	162	81
TOTAL STUDENT-WEEKS IN FIELD MODULES	19	19	38	22	50	149	44	24	87	69	22	76	619	
TOTAL HALF-COURSE EQUIVALENTS IN FIELD MODULES	9.5	9.5	19	11	25	74.5	22	12	43.5	34.5	11	38		309.5

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

26% of credits in entire program earned at QUBS in 1995  
 (21% in 1994; 13.8% in 1993; 19% in 1992; 14.1% in 1991; 16.3% in 1990)

34% of Queen's credits earned at QUBS in 1995  
 (38.9% in 1994; 28.4% in 1993; 33.6% in 1992; 15.8% in 1991; 24% in 1990)

## *Naturalists' Workshop 1995*

In 1995, QUBS offered its seventeenth edition of the naturalists' workshop. Recognizing that other uses of the station have been increasing, yet wanting to maintain the naturalists' workshop program, a major format change was required. Instead of a week-long workshop, three shorter sessions were offered in 1995:

### **1) Harbingers of Spring - May 11 - 14, 1995**

Focus in this early season workshop was on amphibians, flora and birds of the Rideau Lakes area in spring. There were 13 participants in this workshop. Instructors included Dr. Francis Cook (Canadian Museum of Nature), Dr. James Pringle (Royal Botanical Gardens), Sharon David (Queen's University - Psychology), Dr. Allen Keast (Queen's University - Biology) and Frank Phelan and Floyd Connor (QUBS).

Bev Caswell received the S.B. Rutherford Scholarship to enable her to attend this session. This scholarship is named for S.B. Rutherford, a former biology teacher at Clarke High School (Orono, Ontario) and a local champion of interest in natural environments. The selection committee for this scholarship is headed by Roy Forrester, a naturalists' workshop alumnus himself. The S.B. Rutherford Foundation plans to make one scholarship available each year.

### **2) Drawing from Nature - July 20 - 23, 1995 in conjunction with the Pearl E. Williams - Llewellyn Hillis Fund**

Turid Forsyth, longtime friend of QUBS and local artist/photographer, offered a hands-on course subtitled "from a sketch to a finished artwork" in which she guided participants through selection of subject matter, composition, sketching and use of watercolours. There were 14 participants in this workshop.

### **3) Wetlands and Geology - July 27 - 30, 1995**

This late midsummer workshop focussed on the types, qualities and features of a variety of wetlands. The bedrock geology and water regime are important determiners of wetland type, so careful consideration of these features will be fundamental. There were 12 participants in this workshop. Instructors included Dr. Sandra McBride (Queen's University - Geological Sciences), Don Cuddy (Regional Ecologist - OMNR), Dr. Francis Cook (Canadian Museum of Nature) and Dr. Terry McIntosh (Biological Consultant).

Field trips included excursions to Deadlock Bay (Cape-Sauriol Environmental Studies Area), Silver Maple Swamp (Pangman Conservation Reserve), Henderson Bog, Stoco Fen, Lime Lake (Marlbank), Bellrock riverine swamp, Two Island Lake (Bonwill Tract) and Cow Island Marsh.

The workshops continue to be well-attended and much in demand. Our singular difficulty is in keeping up with the participants. These people are keen! They want to do it all. Our instructors deserve special thanks for being inspiring, informative and equally enthusiastic as the workshop participants.

A special vote of thanks to all QUBS regulars! Workshop participants benefit greatly from interaction with field researchers working on-site at an active biological research station.



## Naturalist Workshop Participants 1995

### Harbingers of Spring

- |                  |   |
|------------------|---|
| Sally Burks      | - Amateur Naturalist - Ottawa, Ontario                                  |
| Bev Caswell      | - Teacher - Orono, Ontario  |
| Pat Chamberlain  | - Amateur Naturalist - Kingston, Ontario                                |
| Moir Drummond    | - Amateur Naturalist - Kingston, Ontario                                |
| Helen Mathers    | - Amateur Naturalist - Kingston, Ontario                                |
| Catharine Hodges | - Amateur Naturalist - Mount Chesney, Ontario                           |
| Sue McLatchie    | - Amateur Naturalist - Ottawa, Ontario                                  |
| Donna McKibbin   | - Park Naturalist - Murphy's Point Provincial Park, Perth, Ontario      |
| Kim Mustard      | - Park Naturalist - St. Lawrence Islands National Park, Mallorytown, On |
| Bill van Geest   | - Consultant - Woodbridge, Ontario                                      |
| Matt Wilson      | - Student - Cambridge, Ontario  |
| Andrew Wilson    | - Student - Cambridge, Ontario  |

### Drawing from Nature

- |                       |  |
|-----------------------|--|
| Nasrene MacDonald     | - Amateur - Hughson's Island, RR1 Elgin, Ontario |
| Cathie Hamilton       | - Teacher - Lansdowne, Ontario                   |
| Ken Otter             | - Student - Kingston, Ontario                    |
| Mary Ev Wyatt         | - Amateur - Kingston, Ontario                    |
| Laura Nagel           | - Biology Instructor - Kingston, Ontario         |
| Lena McPhee           | - Amateur - Kingston, Ontario                    |
| Allen Keast           | - Professor - Kingston, Ontario                  |
| Dorothy Young         | - Amateur - Kingston, Ontario                    |
| Guy Thorne            | - Amateur - Kingston, Ontario                    |
| Penelope Battey-Pratt | - Student - Inverary, Ontario                    |
| Nancy Lemon           | - Librarian - Kingston, Ontario                  |
| Seline Wong           | - Student - Kingston, Ontario                    |
| Tyler McNamee         | - Student - Kingston, Ontario                    |

### Wetlands and Geology

- |                     |   |
|---------------------|---|
| Catherine Hodges    | - Amateur Naturalist - Mount Chesney, Ontario                           |
| Moir Drummond       | - Amateur Naturalist - Kingston, Ontario                                |
| Rose-Marie Chretien | - Interpreter - Cooper's Marsh, Raisin River Conservation Authority     |
| Laurie Richardson   | - Teacher - Belleville, Ontario   |
| Bob Richardson      | - Amateur Naturalist - Belleville, Ontario                              |
| Karen Fullbrook     | - Amateur Naturalist - Aurora, Ontario                                  |
| Peter Dirks         | - Consultant - Aurora, Ontario  |
| Ken Robinson        | - Park Naturalist - St. Lawrence Islands National Park, Mallorytown, On |
| Lee Childs          | - Amateur Natralist - Elgin, Ontario                                    |
| Susan Purves        | - Interpreter/Outfitter - Baysville, Ontario                            |
| Deborah Wattie      | - Amateur Naturalist - Chaffey's Lock, Ontario                          |
| Joanne Baker        | - Amateur Naturalist - Elgin, Ontario                                   |

## I: Research conducted by Queen's University Personnel in 1995

### Dr. Lonnie Aarssen

"Plant ecology and evolution"

Christopher McPhee - "Responses to shoot apex removal in prostrate plant species: A test of the phalanx efficiency hypothesis and guerilla efficiency hypothesis for apical dominance." - B.Sc. Thesis.

This study is designed to investigate patterns of apical dominance in prostrate plant species and explore hypotheses for its adaptive significance. We predict that apical dominance serves to minimize overlap and interference between adjacent prostrate shoots. Hence, removal of the shoot apex should result in undercompensatory growth responses rather than the usual compensatory or overcompensatory responses common in upright plant species. Several species were collected for a common garden experiment in the New Barn Field. Effects of shoot apex removal were recorded in terms of biomass and in terms of meristem allocation.

Shane McCloskey - "Relationship between successional status and indicators of old-growth forest at Queen's University Biological Station" - B.Sc. Thesis, Queen's University

This study investigates the relationship between successional stage and forest structural features at QUBS. We hypothesize that relative successional stage correlates with patterns in structural features (e.g. snag density, woody debris, canopy gaps) commonly identified as indicators of proximity to "old growth" stages. The purpose was to document the extent to which these indicators show the predicted trends in forests of this region. Several sites in different stages of succession were surveyed in the summer and autumn and detailed species composition and stand structural data were recorded.

Assistant: William McLeish

### Theses:

Symonds, H. 1995. Effects of architectural modification on reproductive output in ragweed (*Ambrosia artemisiifolia*). B.Sc. Thesis. Dept. of Biology, Queen's University.

### Publications:

Murphy, S.D. & L.W. Aarssen. 1995. Reduced seed set in *Elytrigia repens* caused by allelopathic pollen from *Phleum pratense*. Can. J. Bot. 73:1417-1422.

Murphy, S.D. & L.W. Aarssen. 1995. Pollen allelopathy in *Phleum pratense* L. (Poaceae): Acidic and whole-pollen fractions cause non-linear reduction in germination, in vitro, of pollen in sympatric species. Int. J. Pl. Sc. 156: 425-434.

Murphy, S.D. & L.W. Aarssen. 1995. Pollen allelopathy in *Phleum pratense* L. (Poaceae): Application of acidic fractions of pollen extracts cause non-linear reductions in seed set in sympatric species. Int. J. Pl. Sc. 156: 435-444.

Murphy, S.D. & L.W. Aarssen. 1995. In vitro allelopathic effects of pollen from three *Hieracium*

species (Asteraceae) and pollen transfer to sympatric Fabaceae. Am. J. Bot. 82: 37-45.

**Dr. Christopher G. Eckert**

**"The how's and why's of self-fertilization in flowering plants"**

The shift from outcrossing to self-fertilization is a major evolutionary trend in flowering plants. Most current work on the evolution of selfing has concentrated on the balance between the cost of meiosis (favouring selfing) and inbreeding depression (favouring outcrossing). However, the adaptive value of selfing is also largely determined by exactly how and when selfing is achieved. This issue has been neglected in the literature. Last year, I initiated an experiment designed to decompose self-fertilization in the partial selfer, *Decodon verticillatus*, into its various functional components. Opportunities for self-fertilization were experimentally controlled by manipulating the gender of individual flowers, and marker gene analysis with protein electrophoresis was then used to reconstruct the resulting mating patterns. This year, we extended this approach to manipulate the opportunities for between-flower and within-clone self-pollination. Preliminary analyses suggest that almost all self-fertilization in *Decodon* occurs through geitonogamy (between-flower self-pollination) and is, therefore, of no adaptive value and can not be favoured directly by natural selection.

Assistants: Marcel Dorken and Christiane Munch

**Katherine Mavraganis - "The ecological & genetic effects of habitat fragmentation in a flowering plant, *Aquilegia canadensis* (Ranunculaceae)" - M.Sc. Thesis**

The fragmentation of continuous habitat into small isolated patches is a major component of human disturbance. Reduced population size and increased population isolation caused by fragmentation may negatively affect population viability through inbreeding depression, reduced genetic diversity, altered biotic interactions, and demographic stochasticity. The effects of habitat fragmentation may be particularly severe in sessile organisms like plants, which have limited powers of dispersal and rely on mutualisms with pollinators for successful mating. Yet, there has only recently been any investigation of the impact of habitat fragmentation on plant populations. This spring, we initiated an investigation of the ecological and genetic consequences of habitat fragmentation in populations of hummingbird-pollinated columbine (*Aquilegia canadensis* - Ranunculaceae) on the St. Lawrence islands and mainland areas at QUBS. We are combining reproductive ecology and population genetics to examine how population size and isolation affect levels of genetic diversity and inbreeding, pollination ecology, reproductive capacity and progeny viability. Preliminary results indicate that the effects of population size on reproductive capacity are ameliorated by a delayed selfing mechanism whereby plants can produce seeds without pollinator visitation. Hence population viability may be strongly affected by the balance between inbreeding and outbreeding which may be indirectly mediated by population size and isolation.

Assistant: Captain Greg Grabas

**Andreka Lapchinski - "Mating system consequences of homostyly in *Decodon verticillatus* (Lythraceae)" - B.Sc. Thesis**

Heterostylous plants provide unique opportunities for understanding mating-system evolution since these complex sexual systems sometimes undergo rapid evolutionary change, especially towards increased inbreeding. Rarely, this kind of evolutionary shift is reflected in intraspecific variation,

allowing us to study the evolutionary fate of novel floral mutants in natural populations. Populations of tristylous *Decodon verticillatus* exhibit a wide range of floral variation including 'homostylous' phenotypes with stigmas and anthers positioned close together within flowers. I studied the morphology and mating patterns of homostylous variants in an otherwise tristylous population at Indian Lake. The morphology of these variant phenotypes and how they are manipulated by pollinators strongly suggests that they are primarily self-fertilizing. However, using floral manipulations in conjunction with marker gene analysis, I showed that, contrary to expectations, the rearrangement of stigmas and anthers in mutant homostyles does not lead to increased selfing. These results emphasize how morphological and behavioural observations can lead to erroneous conclusions regarding mating patterns in plant populations.

**Maryl Allen - "Cryptic self-incompatibility and the maintenance of outcrossing in tristylous *Decodon verticillatus* (Lythraceae)" - B.Sc. Thesis**

Flowering plants have evolved an array of morphological and physiological mechanisms that influence mating patterns. The best-studied of these are the self-incompatibility (SI) systems. About half of all angiosperms possess some kind of strict physiological barrier to self-fertilization. Recent work has revealed another class of facultative or "cryptic" SI systems. However, at present, cryptic SI has been well documented in only a handful of species, and we know nothing of the underlying genetic, molecular or physiological mechanisms. Experiments using genetically marked pollen have provided preliminary evidence for cryptic SI in *Decodon verticillatus*. I tested for the operation of cryptic SI in more detail by experimentally selfing and outcrossing plants in a natural population at Cow Island Marsh, and comparing the relative growth of self and outcross pollen tubes using fluorescence microscopy. Preliminary results suggest that outcross pollen tubes enjoy an early head-start in competition with self pollen tubes. Cryptic SI may, therefore, be an important mechanism maintaining outcrossing in *Decodon verticillatus*.

**Greg Grabas & Christiane Munch - "The effect of floral trimorphism on pollen flow & pollen tube growth in *Decodon verticillatus* (Lythraceae)"**

Spatial positioning of male and female sex organs within flowers is thought to be under strong selection in outcrossing, animal-pollinated plant populations. Testing this hypothesis requires an examination of the reproductive costs and benefits of alternative floral morphologies. Last summer, I exploited the floral trimorphism in *Decodon verticillatus* to examine the effect of variation in style length on two components of female reproductive success: pollen capture and seed set. I found that, at Cow Island Marsh, flowers of the long-styled morph set fewer seeds than flowers of the mid- or short-styled morphs, in part, because stigmas on long styles capture fewer pollen grains. This summer, I teamed up with Christiane to examine how the physical structure of style constrains seed set by limiting the number of pollen tubes reaching the ovary. Estimates of pollen tube attrition obtained through experimental hand-pollinations combined with fluorescence microscopy indicate that, contrary to expectations, longer styles do not suffer higher rates of attrition. Hence, stigma position rather than style length, *per se*, seems to be the main determinant of variation in seed set.

**Publications:**

Eckert, C.G. & K. Mavraganis. 1996. Morph loss and anther position in dimorphic populations of tristylous *Decodon verticillatus* (Lythraceae). American Journal of Botany in press.

Eckert, C.G., D. Manicacci & S.C.H. Barrett. 1996. Genetic drift and founder effect in native versus introduced populations of an invading plant, *Lythrum salicaria* (Lythraceae). Evolution in press.



Eckert, C. G. & S. C. H. Barrett. 1995. Style morph ratios in tristylous *Decodon verticillatus* (Lythraceae): selection versus historical contingency. *Ecology* 76: 1051-1066.

#### Dr. Dolf Harmsen

Seline Wong - "Patterns and patchiness in successional sequences in old field communities in eastern Ontario" - M.Sc. Thesis.

In what appeared superficially as a fairly homogeneous hay field in 1975, major patchiness has developed over the past two decades, with some sharp ecotones. This project attempts to correlate this patchiness with such variable scale inputs as climatic, soil and seed source factors. It will also focus on various positive feedback processes that enhance heterogeneity which is randomly imposed on a homogeneous baseline condition. All woody plants were re-tagged when necessary, their condition measured and described, and located on the maps prepared in 1994. All vegetation was resampled in June and again in September. Experiments were carried out on seed germination, seed dispersal and seedling survival for a number of woody species.

Assistants: Gwen Willick and Kirsten Querbach.

Martin Damus - "Interference competition between plant bugs of the genus *Lygus* and the goldenrod beetle, *Trirhabda virgata*".

Previous observations indicated a strong negative impact of a beetle outbreak on the reproductive success of the *Lygus* bugs. This project was a preliminary experiment aimed at establishing a field experimental method which will quantify this effect, and will establish if this is a direct beetle-on-bug effect, or an indirect effect via the goldenrod plant. If funds will be found, the experiment will be carried out in 1996.

Mike Guzowski - "The breeding systems and insect pollinators of two species of dogwood, *Cornus racemosa* and *C. obliqua*".

Flower buds of both species of *Cornus* were bagged in situ and experimentally manipulated in order to establish their breeding system. During flowering pollinators were collected and identified. Both species are self-incompatible, xenogamous shrubs. The main pollinators in the Lake Opinicon area are andrenid bees, halictid bees, bumble bees, syrphid flies, bombyliid flies and mordellid beetles. *Cornus racemosa* is also visited by cerambycid and scarab beetles. *Cornus obliqua* is not, possibly because it flowers one or two weeks later.

Drs. Dolf Harmsen and Rowland Tinline (R.T. - Department of Geography)

Sarah Totton - "Raccoon social behaviour and home ranges" - M.Sc. Thesis

This project focusses on the social behaviour, specifically the frequency of physical contact between individuals in a population of raccoons using a common feeding site. The study is based at the Queen's University Biological Station. In addition, nightly movements and daytime resting sites were recorded for some members of this population, using radio telemetry. Data from this study will be used in a computer model to help predict the incidence and spread of raccoon rabies when it enters Ontario. This will help the Ministry of Natural Resources to optimize an aerial baiting program to vaccinate raccoons for rabies.

Assistants: Liane Smail, Josef Lugarich and Alix Thompson.

#### Drs. Dolf Harmsen and Adele Crowder

##### "Patterns in succession in old field communities"

This long term project (1975 - present and ongoing) continued with vegetation sampling, upkeep of cornerposts and perimeter rope of research plots. The short term projects conducted by Ms. Wong, Mr. Damus and Mr. Guzowski are nested in this long term project, as have several previous ones.

##### Theses:

Snihura, L. 1995. Herbivory of the meadow vole (*Microtus pennsylvanicus*) and its effects on old-field plant succession. B.Sc. Thesis, Department of Biology, Queen's University, Kingston, Ontario.

Seigel, N. 1995. Seed germination in five sympatric species of *Cornus* as a component of life history strategies. B.Sc. Thesis, Department of Biology, Queen's University, Kingston, Ontario.

#### Dr. William C. Leggett

##### "Fish production and recruitment"

My research focuses on the interacting effects of biotic and abiotic variables on the production and recruitment dynamics of fishes. My interest is in the identification, evaluation and quantification of these effects. The ultimate goal is to use this knowledge as a guide to the prediction and management of these features of the life history and dynamics of fish populations. My postdocs, graduate students and I have therefore chosen to focus our research on species and environments that maximize the potential for such advances. This has lead us to work in both freshwater and marine systems using a variety of approaches, from highly controlled laboratory and in-situ experiments to comparative field studies of different habitats and species.

Much of this work has relied on access to field sites and stations where such experiments and field studies can be most effectively carried out on the species and environments of interest. The freshwater components of this work have, until now, been conducted almost exclusively at the Lac Memphremagog and Mont St. Hilaire field stations of McGill University. My recent move to Queen's University, the proximity of the Queen's University Biological Station to Kingston, the quality of the facilities available there to support field and laboratory studies, and the recent acquisition of new properties containing many lakes of different biological and physical types have caused me to relocate the freshwater aspects of my research to QUBS. Up to now we have done preliminary testing of equipment and collection of organisms to examine the potential of future studies at QUBS. Our research examines two broad issues:

1) with Dr. Joel Elliott (PostDoc), we plan to study the importance of variability in environmentally or genetically determined larval growth rates as regulators of survival in largemouth bass. Samples of largemouth bass juveniles have been acquired from QUBS and a preliminary examination of their otolith microstructure has been conducted. The otoliths are adequate for age and growth analysis, and future studies will involve: 1) laboratory rearing of individual larval bass to determine the precision of back-calculated estimates of size-at-age from otolith increment data; 2) laboratory rearing experiments to quantify the influence of maternal effects and temperature on growth rates of larvae; 3) field experiments with groups of larvae (guarded by males) to examine mortality rates and size-dependent mortality in the presence and absence of predators; and 4) field verification of selective, growth-based, mortality through reconstruction of growth rates from otoliths of wild

larvae belonging to a single cohort collected over time. The results of the study will be incorporated into models to predict fish growth and survival under varying environmental conditions.

2) with Dr. John Dower (PostDoc), we are studying the influence of microscale turbulence and upwelling on the feeding success of larval fishes. A major component of this work involves monitoring local environmental conditions. In 1995, we used QUBS as a testing ground for our new environmental monitoring system. This provided useful preliminary calibration data for field studies conducted in Newfoundland in July and August of 1995.

### Dr. Heather Proctor

"Male gamete-packaging and transfer strategies"

"Does pollen lifespan correlate with expected time to deposition in orchids?"

Whereas most flowering plants have powdery pollen, capable of being removed and deposited as individual grains, orchids have more condensed pollen packets called *pollinia* that can be removed and deposited as single units or as smaller subunits called massulae. Along with this variation in packaging modes orchids vary in whether they offer a reward to pollinators. Some provide nectar or fragrant oils to pollinating insects whereas others provide nothing in return for these services and instead trick the insects into transferring pollen. A third category of orchids makes do with no pollinators at all, being obligatorily *auto-pollinating*. Pollen transit time - time from removal of pollen from anthers to deposition on stigmas - should be shortest in auto-pollinating orchids, intermediate in rewarding ones, and longest in deceptive species. This latter prediction comes about because after visiting a non-rewarding flower insects tend not to revisit that type immediately. Species with longer expected transit times should have pollen capable of surviving longer once removed from the anther. Thus I predict that pollen from deceptive orchids should remain fertile longest, that from auto-pollinating the shortest, and that from rewarding species should have intermediate lifespans.

This summer I began a two-year project with studies on two deceptive species of orchid, *Calopogon tuberosus* and *Cypripedium reginae*. The study site for *C. tuberosus* was a floating bog mat near Upper Rock Lake, and for *C. reginae* it was the Purdon Conservation Area west of Perth. I removed pollinia from a flower and either placed them immediately on the stigma of another flower or maintained them at a constant 20° C for 1, 2, 4 or 8 days before depositing them. I bagged the pollinated flowers and collected the pods after they'd developed. Pods were weighed and frozen. There was no evidence that pollen age affected either pod set or pod weight. I am in the process of counting seeds and checking for the presence of viable embryos. Next season I plan to repeat this experiment on rewarding species such as *Platanthera dilatata*, which is also common at the Purdon Conservation Area.

Assistant: Sean Griffin

"Sperm transfer mode and gametic investment in male water mites (Acari: Hydracarina)"

One hypothesis to explain the evolution of direct sperm transfer (copulation) from indirect transfer is that of gametic economy. Indirect transfer typically involves the production of large amounts of sperm, either as free spermatozoa or packaged in *spermatophores*, to ensure that some of it is intercepted by females; direct transfer is assumed to require less sperm and glandular products because the gametes are assured of reaching a female. However, this hypothesis has never been tested, most likely because there are few taxa in which closely related species both do and do not

copulate. Water mites, a group of about 5000 species of aquatic arachnids, are one of those rare taxa.

The waters around QUBS are blessed with an astounding diversity of water mites, both copulating and non-copulating. Last summer I continued a long term study to determine the correlation between testis and accessory gland size and sperm transfer mode by collecting and preserving male water mites from about 10 spp. Representative specimens have been sectioned and stained, but I haven't yet reconstructed the relative volume of testes and glands. I hope to be able to work out histological and computer glitches this coming year.

Frances Fee - "The effect of female choice on male copulatory courtship in spiders" - M.Sc. thesis

Spiders were collected from QUBS and its immediate area. The collection was assembled to determine which species are commonly found in the area. This information will be used to help choose my study species. I will be testing the hypothesis that female spiders chose the males that inseminate their eggs based on behavioural cues exhibited during copulatory courtship.

Neera Garga - "The evolution of warning colouration in water mites" - M. Sc. thesis

Many water mites are brightly coloured and this phenomenon is rare among aquatic invertebrates. I tested the hypothesis that conspicuousness has evolved as a means of advertising mite distastefulness to predators (namely fish). The hypothesis also predicts that red terrestrial ancestors of water mites should not be distasteful to fish. Although the bulk of my four month field season was devoted to the first aspect of the hypothesis, I carried out some preliminary feeding trials of terrestrial red mites, water mites with bluegill and pumpkinseed sunfish from Lake Opinicon as predators. I sampled 36 bodies of water (fish-absent and fish-present) around the QUBS area to investigate whether fish-present bodies of water had a greater proportion of brightly coloured mites than fish-absent bodies of water. My preliminary analyses suggest that the fish-predation hypothesis is not valid as nearly all of the fish-absent bodies of water have high proportions of brightly coloured mites and some fish-present bodies of water contain no brightly coloured mites.

Sean Griffin - "Floral symmetry in angiosperms focusing on the Orchidaceae" - M.Sc. thesis

Early in angiosperm evolution a link formed between flower function and pollinator behaviour. This link results from the plant's dependence on pollinators to deliver male gametes to other conspecifics for fertilization. To ensure pollinator fidelity, flowers evolved species-specific shapes, colours, and rewards (nectar, waxes, pheromones). I hypothesize that symmetry of the flower also plays an important role in identifying the plant to its pollinator species. To test this I plan to compare floral symmetry of obligately outcrossing species with species that are less dependent on insect mediated pollen transfer. The Orchidaceae contain some of the most complex examples of both pollinator relationships and floral morphologies, which make them ideal candidates for this study. This summer I surveyed local populations of orchids and other flowers and made prospecting collections.

Karen Wilkinson - "Mating behaviour in *Arrenurus* water mites: a comparative study of intersexual conflict" - B.Sc. thesis

Conflict between the sexes during mating may lead to the evolution of sexual dimorphism and coercive male behaviour. Water mites of the genus *Arrenurus* provide a spectacular example of species-specific dimorphism in which the males have a wide range of hindleg and hindbody modifications ("cauda") and females are essentially monomorphic. Species in the subgenus *Arrenurus*



are characterized by having males with an intromittant device, the petiole, while males of the subgenus *Megaluracarus* lack this structure and transfer sperm in an indirect manner that appears to require full female cooperation. This summer I examined the courtship and sperm transfer behaviour of three local *Arrenrurus* species, two of which had petioles and one that lacked it.

*Drs. Heather Proctor and Stephen Loughheed*

"The evolutionary history of water mites as revealed by mitochondrial and nuclear DNA sequence"

Water mites (Subclass: Acari, Cohort: Parasitengona) are a species-rich group of invertebrates with an almost cosmopolitan distribution. They have become increasingly important in comparative studies of mating systems, and hold great promise as bio-indicators of the "health" of freshwater ecosystems. However, our knowledge of the evolutionary history of the parasitengonid mites is fragmentary at best, and is based primarily on external morphological characters. Recent technological advances in molecular systematics, especially with respect to directly assaying phylogenetically-informative variation in contiguous stretches of mitochondrial and nuclear DNA sequence, have allowed us to greatly clarify a wide variety of systematic questions. Yet, to date, this suite of techniques has not been applied to the phylogenetics of water mites. This summer we collected representatives of 10 genera of water mites from water bodies at and near QUBS, as well as terrestrial relatives of these mites (Trombididae) to use in future molecular systematic investigations.

Assistant: Kylie Tanner

*Dr. Laurene Ratcliffe*

"Acoustic communication and mate choice in birds"

Field work in 1995 continued studies of sexually-selected signalling behaviour in chickadees, and song repertoire structure and function in warblers.

Ken Otter - Reproductive Strategies of Female Black-capped Chickadees - PhD Thesis.

1. Extra-pair paternity in the Black-capped Chickadee. Ken Otter, Laurene Ratcliffe and Peter Boag.

1995 was the final year for collection of blood samples of nestlings and adults in a four year study investigating the relationship of male rank and extra-pair paternity success. Black-capped chickadees are among the growing list of species in which females are the sex that actively seek extra-pair copulations. Based on 42 nest analyzed to date, extra-pair young appear to occur in about 18-20 % of nests, with as much as 100% of the nestlings in nests with extra-pair young being fathered by a neighbouring male. In 1995, we collected an additional 16 nests to add to the sample. Our aim is to test the theory originally proposed by Susan Smith (1988) that female chickadees are choosing higher ranked males than their mates as extra-pair partners in an attempt to obtain better genes for their offspring than their own mate can provide. During the winter of 1995, 95 banded adult chickadees were observed at feeders and dominance interactions were tabulated to determine the relative ranks of males to use as an index of relative male quality. These data will be combined with DNA fingerprinting, and newly developed microsatellite, analysis of paternity to determine if extra-pair males are dominant to the behavioural fathers of extra-pair young.

Assistants: Colin MacDonald, Christine James, Sarah Cosh

2. Female initiated divorce in black-capped chickadees. Ken Otter and Laurene Ratcliffe.

If females use extra-pair copulations to increase their reproductive success, further increases could come from deserting a current breeding partner if a better mate becomes available. This has been called the "Better-options" hypothesis of why divorce (breaking of a pair bond with one individual and pairing with another despite the original partner remaining alive) occurs in some long-term pairbonding species, like chickadees (Ens et al. 1993). No experimental studies had been conducted to test this hypothesis, so we conducted a series of female removals at the beginning of the breeding season in an attempt to create opportunities for pairs to divorce. Chickadee pairs form during the winter and are stable by about January. Using the dominance data collected over the winter, we chose 7 high ranking and 6 low ranking males whose mates would be removed. Females were removed from the territories at the end of April for 48 hrs, thereby widowing the males and creating opportunities for neighbouring females to desert their mates to re-pair with one of the widower males. As predicted, 6/7 high ranking widowers repaired within 48 hr, the replacement female deserting her lower ranked mate for the widower male. Only 1/6 low ranking males was similarly chosen by a divorcing female. After returning the original, dominant females, all replacement females were driven off the territories and almost all repaired with their original mate. The results suggest that female chickadees are constantly assessing potential opportunities to increase their reproductive status by pairing or mating with a higher ranked male, and that what may prevent the females from pairing with these males originally is the higher ranked female the males are mated to.

Assistants: Colin MacDonald, Christine James

3. Individual recognition mate's calls by female chickadees. Ken Otter, Mitch Njegovan and Laurene Ratcliffe.

Chickadees use a soft vocalisation, faint fee bee, similar in structure to the species song, apparently to coordinate feeding activity at the nest (Ficken et al. 1978). During incubation, males feed females at the nest. They "announce" their arrival by faint fee beeing at which time the female either leaves the nest for the male to feed her or the male flies to the nest to transfer the food. During preliminary recording in the nest cavity in 1994, we found that incubating females vocalise in response to male calls, which seems to be the stimulus for the male to fly in and feed. We were interested in whether the females are able to identify calls of their mates from other males and responded specifically to these, similar to that found in kingfishers. Using microphones in the nest to record female responses, we played calls of their mates and calls of strange males, as well as song of a control species (yellow warbler), to the incubating females. The data from this study awaits analysis.

Assistant: Christine James

Ruth Woodward - "Singing behaviour of the Cerulean Warbler" - M.Sc. Thesis

Bird song performs two important functions: territorial defence and mate attraction. Unlike most songbirds, males of several wood warbler species use different song types in different contexts. For example, Type I songs are used in intersexual communication (e.g. mate attraction) while Type II songs are used for intrasexual interactions (e.g. territorial defence). Because of this dichotomy, wood warblers represent one of the best groups for the study of the functionality of animal communication.

I was interested in determining whether or not cerulean warblers exhibit the Type I / Type II song system of other wood warbler species. The cerulean warbler (*Dendroica cerulea*), is a little-studied member of the wood warbler family (Parulidae). In contrast to the extensive knowledge of song systems of other warblers, there are no published quantitative studies of cerulean warbler song and virtually nothing is known about this species' singing behaviour. The cerulean warbler is threatened over most of its breeding range in the north-eastern United States; however, there is a local

abundance of breeding cerulean warblers (1-5 pairs/km<sup>2</sup>; Martin and Robertson 1994) at my study site at the Queen's University Biological Station, Lake Opinicon, Ontario.

In the summer of 1995, I made extensive recordings and detailed behavioural observations of 20 cerulean warbler males with the goal of assessing whether or not cerulean warblers exhibit the Type I / Type II song system of other wood warbler species. In these other species, Type I songs tend to be sung by males during the day, inside their territories, when they are unmated or near a female. The use of Type I songs tends to decline after pairing. Type II songs are sung more at dawn, and are usually sung at a faster rate than Type I songs. Male warblers tend to sing Type II songs at locations where male-male interactions frequently occur (e.g. territory borders); these songs are used by males more as the breeding season progresses. If cerulean males consistently vary the songs they sing based on the different contexts mentioned above, I will have found evidence for a Type I / Type II song system. Results from this study will help to increase our knowledge about the phylogeny of the wood warblers, particularly with respect to the origins of song systems and singing behaviour.

**Assistants:** Ken Otter, Taali Rooneem, Becky Whittam

**Publications:**

Chruszcz, B.J., Otter, K., & Ratcliffe, L. (submitted) Variation in song structure in the black-capped chickadee (*Parus atricapillus*) during sustained singing. *Condor*

Fotheringham, J. R. and L. Ratcliffe. 1995. Song degradation and estimation of acoustic distance in Black-capped Chickadees (*Parus atricapillus*). *Can. J. Zool.* 73: 858-868.

Martin, P. R., Fotheringham, J. R., Ratcliffe, L. and R. J. Robertson. 1996. Response of American redstarts (Parulinae) and least flycatchers (Tyrannidae) to interspecific playback: the role of song in aggressive interactions and interference competition. *Behavioral Ecology and Sociobiology*: in press.

Otter K & L Ratcliffe. 1996. Female initiated divorce in a monogamous songbird: abandoning mates for males of higher quality. *Proc. R. Soc. Lond. B.* in press.

Otter, K., Chruszcz, B.J., & Ratcliffe, L. (in review) Honest advertisement and song output during the dawn chorus of black-capped chickadees. *Behav. Ecol.*

**Theses:**

Chruszcz, B. 1995. Song variation and winter dominance in the black-capped chickadee (*Parus atricapillus*). Hons. BSc thesis, Queen's University.

Fotheringham, J. R. 1995. Ecological influences on song structure and singing behaviour of wood warblers (Parulinae). MSc thesis, Queen's University.

Woodward, R. 1995. A test of the acoustic adaptation hypothesis using songs of the Cerulean Warbler. Hons. BSc thesis, Queen's University.

**Dr. Victoria Remenda** (Department of Geological Sciences)

**"The groundwater/surface water interface"**

As a hydrogeologist, my research interest is the interface between groundwater and surface

water and what physical and geochemical processes occur there. This past year my students and I undertook a preliminary study of the Bracken property.

**Thesis:**

Nunney, J. L. Preliminary investigation of the Bracken property in Newboro, ON.: Emphasis on and an Analysis of Field methods for Groundwater/surface water interaction. B.Sc. thesis, Department of Geological Sciences, Queen's University. 41 pages.

**Dr. Raleigh J. Robertson**

**"Evolution of breeding and parenting strategies in birds"**

In 1995, our studies on mating systems and reproductive strategies of birds included some new experimental approaches to examining causes and consequences of extra-pair paternity in Tree Swallows *Tachycineta bicolor* and Eastern Bluebirds *Sialia sialis*. NSERC International Post-doc Bart Kempenaers organized a challenging study and supervised a team of field workers during a marathon season from April through July. RJR assisted with parts of the study plus obtained family group blood samples from the undisturbed Hughson's Tree Swallow grid for a 5th consecutive year.

Wally Rendell returned (having completed his MSc at Simon Fraser Univ.) to Queen's and QUBS to conduct his PhD research on determinants of the relationships between clutch size, box size and fledging success in Tree Swallows.

**"Effects of forest management strategies on woodland bird communities"**

Continued funding from the Eastern Ontario Model Forest, plus the Ministry of Natural Resources Science and Technology Transfer Unit enabled us to expand our studies of Cerulean Warbler *Dendroica cerulea* breeding biology in relation to forest management practices. Catherine Oliarnyk headed this project as her MSc study. Dale Kristensen continued his project on habitat values of red pine plantations for breeding bird communities. His study, which is now complete, has developed some management recommendations.

**Dr. Bart Kempenaers** - "Extra-pair paternity and parental care in Eastern Bluebirds and Tree Swallows"  
- Post-doctoral fellow

Theory predicts that a male bird should provide parental care to his brood in relation to his (perceived) paternity of that brood. We studied the relationship between paternity and parental care in two species: the Eastern Bluebird and the Tree Swallow. Populations of both species were studied in the Opinicon Lake area near QUBS. Earlier studies of the same populations have shown that extra-pair paternity occurs frequently, but that male birds do not seem to invest less if they lose paternity. We experimentally decreased the male's confidence of paternity by removing the female during the critical fertile period (just after egg-laying) and recorded male and female copulation behaviour before and after female release. We assessed the paternal investment of males by determining male and female feeding rates when chicks were 4, 6, 8, 10, 12 and 14 days old. We also collected blood samples from all adults and nestlings for DNA-fingerprint analyses.

Fingerprinting analyses are performed in collaboration with Dr. Brad Congdon (lab of Dr. Peter Boag) and Dr. Maria Hoi-Leitner (Konrad Lorenz-Institute for Comparative Ethology in Vienna, Austria).



The study was conducted in nest box grids on the Hughson Tract, a temporary grid (Jeremy's Grid) graciously allowed on the field owned by Stan Teeple, as well as in boxes on the Hilda and John B. Pangman Conservation Reserve, on the Bracken Tract, and along the roads in the Opinicon area. This study was supported by an NSERC International Fellowship to BK.

Assistants: Ellen Bentley, An Blicek, Vicky Boomgaardt, Lara Edwards, Richard Lanctot

Vicky Boomgaardt - "A study of the vocal repertoire of the Tree Swallow during the breeding season" - B.Sc. thesis

Previous studies of Tree Swallow vocalizations have identified 5 major call types and one song pattern of the Tree Swallow (Sharman et al. 1994). The goal of my summer research was to further investigate the function and behavioural context of these vocalizations. During the course of the Tree Swallow breeding season (May 1 to July 1), I recorded males nesting in the nestboxes on Jeremy's Grid to determine if significant variation in the male vocal repertoire existed between each of the four breeding stages: nest-building, egg laying, incubation and brood-rearing. Additionally, I examined the relationship between the degree and use of vocalizations and the social structure of the tree swallow population by comparing the vocal output of Tree Swallows nesting in high densities at Jeremy's Grid (colonial breeders) and those breeding in low density areas along Opinicon Road (solitary breeders). Sonograph analysis of both groups of recordings was completed in Dr. Laurene Ratcliffe's lab at Queen's. My results indicate that while both colonial and solitary males have similar rates of vocal output during the nest-building stage, the frequency of individual call types varies between them; colonial males spend a greater proportion of their time and energy defending their territories from neighbouring males while solitary breeding males employ song primarily as a means of communicating with their mates. Furthermore, colonial males appear to reduce their vocal output as the breeding season progresses. This suggests that male Tree Swallows employ song more as a means of mate attraction than mate guarding, consistent with previous behavioural studies. My study was conducted in a temporary nestbox grid known as Jeremy's Grid, graciously allowed on Stan Teeple's field and in nestboxes along the Opinicon Road.

Funding for this project was supplied by an NSERC operating grant to Dr. Robertson. Special thanks to Dr. Bart Kempanaers for guidance throughout the study.

Catherine Oliarnyk - "Habitat use and reproductive success of Cerulean Warblers in southeastern Ontario" - MSc thesis

The Cerulean Warbler is the most rapidly declining migrant songbird in North America. Threatened throughout most of its breeding range, and listed as vulnerable in Ontario, very little is known about the breeding biology and habitat requirements of this species. The area around QUBS supports one of the densest breeding populations of Cerulean Warblers in Canada. We monitored this population at two sites near QUBS (the newly acquired Pangman Reserve and at Skycroft, near Telephone Bay) and at a site on the property of David Hahn, on Canoe Lake, which has undergone light thinning of large oaks and poplars over the past five years. The goal of this study is to determine what habitat parameters are critical for successful Cerulean Warbler reproduction, and whether light forest management has an effect on the reproductive success of this species.

The light management that has occurred on David Hahn's property had no significant effect on the reproductive success of this population. Therefore, the conservation of this species may be compatible certain types of forest management. While previous studies have demonstrated that Ceruleans require large tracts of mature hardwood forest for successful reproduction our study has shown that, even within such forests, there are certain microhabitat features such as large trees (greater than 30 cm diameter at breast height) and canopy density that significantly distinguish the habitat at successful nest-sites from both random spots within a territory and unsuccessful nest-sites.

This study was supported by a grant from the Eastern Ontario Model Forest and an NSERC operating grant to Dr. Robertson.

Assistants: Brent Gurd, Andre Patry, Becky Whittham

Clive Goodinson - "Foraging behaviour of Cerulean Warblers during breeding" - BSc thesis

Little quantitative data on the Cerulean Warbler's foraging behaviour has been published. General descriptions have qualified the species as an insectivorous foliage-gleaner which tends to spend most of its time in the upper half of the canopy in mature deciduous forests (Hamel 1992, Parker 1994, Robbins et al. 1992). A detailed quantitative study of its foraging behaviour will provide further insight into the structure and dynamics of forest bird communities, and will help to determine what characterizes the Cerulean Warbler's preferred breeding habitat. Such information may be useful in the formulation of land management strategies conducive to conservation of this neotropical migrant. I conducted my study on the same two sites used by Catherine Oliarnyk (above). After we mapped individual territories, I was able to follow any particular male or female and record such observations as foraging height, foraging manoeuvres and tree species used. The various hypotheses I set out to test concern intersexual differences in foraging behaviour and species-typical foraging patterns. Results confirm that Cerulean Warblers are primarily foliage-gleaners, at our sites feeding mostly upon lepidopterous larvae. More interesting are the significant correlations between frequency of observations of both males and females in particular tree species and abundance of those tree species, as measured by percent total basal area. In other words, males and females do not exhibit preferences for any particular tree species, but rather use them in the proportion in which they occur. The correlation for females is somewhat weaker, indicating that perhaps other factors, such as reduction of intersexual competition by spatial segregation, are involved.

Funding for this project was supplied by an NSERC Undergraduate Scholarship and a grant from the Eastern Ontario Model Forest to Dr. Robertson.

Dale Kristensen - "Assessing songbird habitat values of Red Pine plantations" - MSc thesis

The MSc portion of this study has been completed in 1995. Data analysis has provided strong evidence that vegetative heterogeneity conferred by hardwood regeneration is a critical component of habitat quality in red pine plantations. A small community of habitat generalists were found to successfully breed in relatively pure plantations and included primarily ovenbirds, chickadees, hermit thrushes, robins and yellow-rumped warblers. Additional species forming a more diverse community (e.g. red-eyed vireos, rose-breasted grosbeaks, red-breasted nuthatches, black and white warblers, and scarlet tanagers) were observed in areas of more substantial hardwood growth. Other critical elements influencing songbird diversity and breeding density included proximity to adjacent upland forests, presence of cavities and snags, and varied topography. Plantation size was not found to influence songbird diversity or abundance.

These findings are now being incorporated into a series of plantation management guidelines that will soon be circulated by STTU (OMNR Kemptville) and Eastern Ontario Model Forest.

In 1996/97 we will be investigating other plantations in eastern Ontario to determine if these management recommendations can be more broadly applied. These studies will form the basis of an honours thesis for a Queen's University student.

Assistant: Andre Patry

Wallace Rendell - "Cavity microclimate and the evolution of clutch size in secondary cavity-nesting birds" - PhD thesis

A general explanation for the evolution of clutch size in birds is the "Individual Optimization Hypothesis", which asserts that females try to match clutch size to the available resources (e.g., food availability) needed to successfully rear young. My study is a unique twist on this hypothesis: I believe clutch size in secondary cavity-nesting birds has evolved to match cavity size, because cavity size may determine the optimal size of brood that can be raised by parents. Secondary cavity-nesting birds lay eggs and raise young in tree cavities, but they are incapable of excavating their own cavity. Therefore, they must locate suitable, unoccupied cavities in which to nest each breeding season. Cavities vary a great deal in their internal dimensions, and previous descriptive and experimental studies have found that these birds lay larger clutches in larger cavities. Cavity size likely constrains brood size and nest success due to the influences of microclimate variables, such as cavity temperature and humidity, on nestling temperature, energy balance, and growth. As an example, as outside air temperature rises, large broods in relatively small cavities may experience unusually high cavity temperatures and humidities, possibly resulting in nestling hyperthermia. For small broods in relatively large cavities the opposite is likely true. Therefore, I believe that the constraints of cavity size and microclimate determine average clutch size by forcing secondary cavity-nesting birds to make a trade-off between the number and quality of young raised in cavities of different sizes. In 1995, I began a 3-year study at QUBS to gather evidence for this hypothesis. I manipulated both brood size (3 or 8-10 young) and cavity size (1000 or 3800 cm) of Tree Swallows breeding in 60 nestboxes at terrestrial grids on the Hughson tract, and at an aquatic grid, the Northeast Sanctuary, on Lake Opinicon. There were four 'box-types': 1) large brood, large cavity, 2) small brood, large cavity, 3) large brood, small cavity, and 4) small brood, small cavity. Throughout the nestling period, I recorded the temperature and relative humidity in nestboxes using small data sensors (HOBOS'a8, Onset Computers, Pocasset, MA). Also, I monitored nestling growth, survivorship, and fledging success for all nests.

This study is supported by an NSERC operating grant to Dr. Robertson, and an NSERC Postgraduate Scholarship to WR.

Assistants: An Blieck, Kelvin Conrad, John Dower, Karen Holder, Bart Kempenaers

Colleen Barber - "Determinants of extra-pair paternity in Tree swallows" - PhD thesis

Tree swallows are considered a socially monogamous species since they typically stay paired together over a breeding season to raise a brood of nestlings. Both males and females feed the young. This species was also assumed to be genetically monogamous, yet DNA fingerprinting results have proven otherwise. Many nestlings within a brood are extra-pair young; they are genetically related to the female at the nest, but not the male.

I am examining the adaptive significance of this mixed reproductive strategy by identifying some benefits of extra-pair copulations. One such benefit is that of "good" genes whereby a female's fitness is increased by mating with males having superior genes (i.e. genes that confer increased viability or attractiveness to the offspring). I have quantified many potential behavioural and morphological cues of quality. This year, I am in the final stages of analyzing this data along with the respective DNA fingerprints, and writing up my findings.

A second objective of this study was to determine the frequency of extra-pair paternity (EPP) of tree swallows in natural cavities and compare it with that found in nestboxes. This comparison is critical to ensure that the high level of EPP observed in box-nesting swallows (as great as 90%) is a natural phenomenon. Of 25 natural-cavity females fingerprinted, 84% obtained fertilizations from extra-pair males. These males fathered a total of 69% of all the nestlings. EPP is therefore not an

artifact of nestboxes, but a real component of the mating strategies of tree swallows.

We sincerely thank the Hughson family, as well as Richard and Karen Nasmith for granting us access to their land. DNA fingerprinting was performed in the Queen's University Molecular Ecology Lab under the supervision of Dr. Peter T. Boag, and the guidance of Denise Michaud-Freeman. Financial support was provided by a NSERC grant to RJR, and grants from the North American Bluebird Society, the Behaviour Society, The Frank M. Chapman Fund, the Sigma Xi Scientific Research Society, the Society of Canadian Ornithologists (Taverner award) and the School of Graduate Studies and Research (Queen's University) to CAB.

Assistants: Mark Hovorka, Heather Ferguson, Kelvin Conrad, Laurie Martinovic, Tedd Robertson, Luis Pascual, Allan Ogden, Laura Santry and Ann Molson.

Jessie Deslauriers

Phoebe response to cowbirds at the nest

Do Eastern Phoebes recognize female Cowbirds as a possible threat? In a continuing project of testing the degree of male and female Phoebe aggression toward female Brown-Headed Cowbirds near a nest in the incubation stage, presentations of model female Cowbirds were made at several nests. A model Song Sparrow was used as a non-threatening control. These presentations were made both silent and accompanied by taped recordings of Cowbird and Sparrow songs.

Least Flycatcher calls and possible "honest advertisement"

For the third year in a row the normally large resident population of Least Flycatchers failed to make an appearance. As a result, a project concerning "honest advertisement" could not be carried out. It was planned to test if a Least Flycatcher male advertises his quality as a mate by singing most in early morning when temperatures are cooler; if he sings when sound carries best, he would sing more in early morning regardless of temperature.

Temporal movement of parulids during spring migration

Mist nets were again set along the hydro line to check for differences in temporal movement during spring migration of selected passerine groups and parulid species in a geographic location which does not serve as a migration "funnel".

Mosses and Lichens

A small collection of assorted mosses and lichens was made for the Fowler Herbarium.

Publications:

Barber, C. A., Robertson, R. J. and Boag, P. T. In Press. The high frequency of extra-pair paternity in Tree Swallows is not an artifact of nestboxes. *Behavioural Ecology and Sociobiology* (Accepted 2 Aug. 1995).

Martin, P. R., Fotheringham, J. R., Ratcliffe, L. M. and Robertson, R. J. In Press. Response of American Redstarts (*Parulinae*) and Least Flycatchers (*Tyrannidae*) to interspecific playback: the role of song in aggressive interactions and interference competition. *Behavioural Ecology and Sociobiology* (Accepted 1 June 1995).

Martin, P. R., Fotheringham, J. R. and Robertson, R. J. A prairie warbler with an intra- and interspecific song repertoire. *Auk* (Accepted 10 April 1995).



MacDougall-Shackleton, E. A. and Robertson, R. J. In Press. Mate guarding tactics used by Great Crested Flycatchers. Wilson Bulletin (Accepted 20 April 1995)

Meek, S. B. and Robertson, R. J. 1995. Time of day of egg laying by Eastern Bluebirds. Wilson Bulletin 107: 377-379.

Rendell, W. B. and Robertson, R. J. In Press. Defense of extra nest-sites by a cavity nesting bird, the Tree Swallow (*Tachycineta bicolor*) Ardea. (Accepted 22 June 1994).

Whittingham, L. A., Dunn, P. O. and Robertson, R. J. 1995. Testing the female mate guarding hypothesis: a reply. Animal Behaviour 50: 277-279.

### **Drs. Bruce Tufts and Raleigh Robertson**

**Heather Ferguson - "Thermal regulation of bass spawning" - MSc Thesis**

We continued to study the thermal regulation of bass spawning this year at two sites, Lake Opinicon and Charleston Lake. Again, we found that bass spawned earlier at Lake Opinicon than at Charleston Lake where bass spawning occurred nearly two weeks after the Lake Opinicon bass initiated spawning. These between-site differences in onset of spawning are likely correlated with the thermal regime of the specific water body, such that at Lake Opinicon, which is a small shallow lake, the water warms more quickly in the spring than at Charleston Lake, a much larger and deeper lake. We also measured water temperature at many locations within each of these sites throughout the bass spawning season to assess the effects of microclimate on the spawning behaviour of bass and thereby determine if local warming rate plays a regulatory role in the initiation of bass spawning. These data will be used to demonstrate that bass spawning times can be predicted, based on the thermal history of the fish. The ultimate goal of this study is therefore to develop a predictive model for bass spawning and to alter current management practices which dictate that the bass fishing season open on the same date each year, irrespective of any annual variation in water temperature.

Funding for this project came through the Cooperative Bass Study, involving the Ontario Ministry of Natural Resources and the Ontario Federation of Anglers and Hunters.

**Assistant: Cory Suski**

## **II. Research by Non-Queen's Personnel in 1995**

**Dr. Jim Bogart** - Department of Zoology, University of Guelph

### **"Evolutionary biology of amphibians"**

My research focuses on amphibian evolution at the species level. Acoustic, genetic and cytogenetic, as well as ecological and ethological methods are employed to try to understand speciation events. Much of my research has investigated the evolutionary significance of polyploid amphibians.

The work that my students are doing at QUBS is part of a large concerted program that is designed to understand more about the biology and the distribution of Canadian species of amphibians and reptiles. QUBS is situated in a very favourable area and has one of the richest herpetofaunas in Canada. Our efforts will be combined with those of other herpetologists across Canada. Our goals are to provide accurate information on present population dynamics of amphibians and reptiles that can be used to monitor trends in the future. With the help of the Ivey Foundation, the Canadian Forest Service, and the Ontario Heritage Foundation, we are importing data into a geographic landscape system (GLS) that will be used for an Ontario herpetofaunal atlas and to provide data to test ecological hypotheses.

**Tana McDaniel - "Resource partitioning in Leopard and Pickerel Frogs" - M.Sc. Thesis**

The focus of my research is resource partitioning in amphibian populations. Part of my work is to determine how closely related species can co-exist ecologically. My research this past summer involved investigating the ecology of two closely related anuran species, *Rana palustris* and *Rana pipiens*. I compare species characteristics such as diet, microhabitat use and choice of breeding sites. These data are used to test the hypothesis that the two species partition resources when sympatric versus exploitation of similar, superabundant resources.

**Tracy Allard - "Juvenile feeding behaviour and habitat partitioning in the Mink Frog"**

During the summer of 1995, I attempted to characterise feeding behaviour and habitat partitioning of the tadpoles of the mink frog. Unfortunately and surprisingly, we could not find any individuals of this species anywhere on or near QUBS properties. As a result, I had to sample a population from the general area of Bishop's Mills, some distance removed from QUBS. Because of the distance to study sites and other difficulties, this project was not completed. I am presently pursuing an investigation of temperature dependant sex determination in the ribbed newt.

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

### **"Evolutionary ecology of parasites and the sexes"**

The theoretical framework of my research is life history theory and how it applies, in particular, to parasite-host interactions and to intraspecific variation in ecology and behaviour of the sexes and different morphs. My research at the Queen's University Biological Station has included studies on the effects of parasites on behaviour and reproductive success of damselflies, on developing theory of insect-parasite interactions, and on testing evolutionary models on the maintenance of two or more morphs within single populations of insects. I also have occasionally studied other topics including sex differences in brain structure and conservation biology issues.

My future research at the Queen's University Biological station (next three years) will focus primarily on the importance of parasites to fitness variation within species, and their potential importance in structuring species assemblages in natural communities. I also will initiate independent studies on the maintenance of genetic diversity within insect (host) populations.

Brian Leung - "Deviations from bilateral symmetry as indices of fitness or environmental stress" - Ph.D. Thesis

I am using mathematical models and empirical tests to investigate the rationale of using deviations from bilateral symmetry of traits as an index of environmental stress and/or fitness of organisms. I use damselflies as model organisms for empirical tests.

Assistant: Greg Miller

Dean McCurdy - "Density-dependent effects on female dimorphism in damselflies" - Ph.D. Thesis

Last year, I investigated the effect of density of damselflies in outdoor enclosures on the frequency and intensity of male-male and male-female interactions as a guide to understanding whether density might influence costs and benefits of being a particular female morph. To date, differential costs and/or benefits to female morphs have not been demonstrated. Next year, I plan to work on intertidal mudflats in the Bay of Fundy examining the influence of nematode parasites on the individual and populations ecology of amphipods.

Assistant: Greg Miller

Gina Schalk "The relationship of low pH to amphibian population declines" - M.Sc. student (co-supervised with Dr. Pat Weatherhead)

Although the causes remain elusive, it appears that populations of amphibians are declining worldwide. My research will examine how low pH interacts with risk of predation, or impact of parasitism, in determining mortality or general health of select species of amphibians. I am also examining whether pH is related to abundance of particular species of amphibians in natural ponds around the Queen's University Biological Station.

Assistant: Greg Miller

Kelley Kissner - "Interspecific variation in defensive behaviour of prairie rattlesnakes" - M.Sc. Thesis (University of Regina)

I am testing hypotheses on the evolution of intraspecific variation (principally sex differences) in defensive behaviour of prairie rattlesnakes and garter snakes at Univ. of Regina. My time at Queen's University Biological Station was limited to 2 weeks this summer to examine the possibility of working on female choice in water snakes, and to start writing my M.Sc. thesis.

#### Publications:

Forbes MRL (in press). More on parasitism and host reproductive effort *Oikos* (letter from editor, 10 Dec. 1995).

Forbes MRL, Leung B. 1995 Pre-fabricated dining shelters as outdoor insectaries: an assessment using *Enallagma ebrium*. *Odonatologica*

Forbes MRL, Teather KL 1994 Variation in male responses to female morphs in *Enallagma ebrium*. *Odonatologica* 23:103-114.

Forbes MRL. 1994. Tests of hypotheses for female-limited polymorphisms in the damselfly, *Enallagma boreale* Selys. *Animal Behaviour* 47:724-726.

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

"Genetic determinism vs phenotypic plasticity in Pumpkinseed Sunfish life histories"

The long term objectives of my research are to explain the high degree of life history variation exhibited by pumpkinseed (*Lepomis gibbosus*) populations. This summer I initiated an experiment to determine the extent to which life histories converge when individuals from early and late maturing populations are reared in a common environment. Mature individuals from five populations in eastern and central Ontario (including Lake Opinicon) and one from northern Pennsylvania were captured in the spring, and individuals from each population were transplanted to an artificial pond at Cornell University. All populations produced offspring in 1995, and some of the females from these progeny are expected to mature in 1997. Percent maturity at age (adjusted for body size) and gonadosomatic indices will be compared at this time to test the hypothesis that reproductive life history characteristics at the population level are environmentally determined. The experiment is being carried out cooperatively with Jeff Arendt, Binghamton University, who is testing the hypothesis that populations occurring sympatrically with bluegills have evolved competitive abilities superior to those of allopatric populations.

Assistant: Kirk Bertschy

Tom Pratt - "The impact of predation on pumpkinseed sunfish life histories"

A preliminary study was carried out in the summer of 1995 to investigate the impact of predation on pumpkinseed life history characteristics. The study was carried out on six lakes in eastern and central Ontario, including Lake Opinicon. Juvenile pumpkinseeds ranging from 45-100 mm total length were collected, sorted into large and small size groups, and presented to natural predators within the lakes. Fish were tethered for 24 h, then checked to determine the rate of loss to predators. Results indicate that, in several lakes, 24 h was too lengthy an exposure for accurate predation rates to be obtained. Results from this work will be used to guide techniques in an M.Sc. project proposed for next summer.

Assistants: Vicki Stevenson, Kim Pratt

Vicki Stevenson - "Influence of juvenile sunfish density and interspecific competition on life history characteristics of pumpkinseed" - B.Sc. thesis

This research followed preliminary surveys of juvenile sunfish density carried out in the summer of 1994 in several central and eastern Ontario lakes. The purpose of my study was to examine the relationship between juvenile sunfish density and reproductive life history traits of pumpkinseeds, as well as the extent of competition between pumpkinseeds and bluegills at the juvenile stage. To assess juvenile sunfish density, I used a strip count method adapted from Keast & Harker (1977). Densities were assessed in six lakes (including Lake Opinicon) in which pumpkinseed life history traits had been previously studied. To estimate the proportion of YOY pumpkinseeds and bluegills in strip counts, samples of YOY in sympatric lakes were seined and identified in the lab. Preliminary results show that juvenile pumpkinseed density is negatively correlated with age and size at maturity and positively correlated with gonadosomatic index; the opposite of what would be predicted by r- and K- selection theory. Correlations between juvenile density, and life history and



growth characteristics were weakened when total sunfish density was used in place of pumpkinseed density. Samples of YOY and yearling sunfish were also collected in order to examine diet overlap, and microhabitat utilization was assessed to examine potential mechanisms for minimizing competition between juvenile pumpkinseeds and bluegills.

Assistant: Kim Pratt

Jeff Arendt - Evolution of intrinsic growth rate in pumpkinseed sunfish (*Lepomis gibbosus*) in response to competition from bluegill - PhD Thesis, SUNY-Binghamton

We used the biological station as a base while collecting adult pumpkinseed from nearby lakes for stocking experimental ponds at Cornell University. Offspring from these fish have been used to examine genetic differences in intrinsic somatic growth rate and likely costs of rapid growth. Fish derived from populations sympatric with bluegill (a competitor) show faster growth rates than do fish from allopatric stocks, presumably because rapid growth allows these fish to quickly pass through the size range in which these two species compete. This rapid growth appears to result in a decrease in skeletal density. Experiments are currently under way to determine the effect of rapid growth on lipid storage, ability to regenerate damaged tissue, fluctuating asymmetry, and immunocompetence.

Assistants: Mike Fox (Trent University) and Steve Frey (undergrad. at Binghamton) aided in the collection of fish. Oleg Latvinsky (undergrad. at Binghamton) aided in analyzing skeletal density of fish.

Dr. James H. Fullard - Department of Zoology, Erindale College, University of Toronto, Mississauga, Ontario

"Insect sensory ecology and neuroethology"

James H. Fullard, Francine Lewis and Tina Gute - "CNS projections of auditory afferents in noctuid moths"

The noctuid moth ear consists of three cells, two chordotonal (A1 and A2 cells) and one non-chordotonal, the B cell. It is known that the A1 cell projects into the central nervous system from the metathoracic into the prothoracic ganglion. Although no direct evidence exists, it has been proposed that this pattern is shared by the non-chordotonal cell, the B cell but the other chordotonal cell, the A2, is supposed to remain within the metathoracic ganglion. Since these projection patterns seem at odds with what is known about the conservative nature of sensory cells, we attempted to determine whether one of these predictions, the prothoracic projection of the B cell was supported. Simultaneous recordings were made of the auditory nerve, where the B cell is known to reside, and the meso-prothoracic ganglion, where it is predicted to reside. By using the spikes of the B cell in the auditory nerve as a trigger to time-average the output of the connective, we concluded that the axon of the B cell does not project into the prothoracic ganglion. These results, when combined with the developmental studies on the ear of the gypsy moth (*Lymantria dispar*), suggest that the CNS identity of the A2 and B cell have been reversed.

Assistant: Kathleen Pendlebury

Suchita Chincholi - "Infra-red video analyses of moth flight following ultrasonic stimulation"

This summer was spent digitising the video images that were recorded in the previous summer of a variety of local moth species. These moths were released at night in dim red light and allowed

to fly across the path of a marked wall while being filmed with a low-light level video camera. Individual frames representing 16.7 msec increments were traced onto a sheet of paper and then digitised into a image analysis programme. The time between positions of the moth represents its velocity before and following bat-like stimulation and the angle from the ground represents its upward or downward direction of flight. These data suggest that erratic flight is not the common response to intense bat-like stimulus and that sustained upward or downward flight might provide for a better chance of avoiding capture by an attacking bat.

Assistant: Kathleen Pendlebury

Publications:

Northcott, M. and Fullard, J.H. The closed-loop nature of the tymbal response in *Cynia tenera*. Brain, Behaviour and Evolution (in press).

Dr. H. Lisle Gibbs - Department of Biology, McMaster University, Hamilton, Ontario

Collaborator: Dr. Keith Hobson (CWS)

Dr. Robert Dawson and Emanuel Milot - "Delineation of Neotropical migrant bird populations using DNA marker and stable-isotope analyses"

Neotropical Migrant birds, or species which breed in the temperate zone and winter in the tropics, are a unique and significant component of biodiversity in Canadian forest ecosystems. Such birds comprise up to 70% of avian species which breed in forest ecosystems in Canada and have shown a major decline in numbers over the past 20 years. Currently, considerable effort both nationally and internationally is being devoted to understand the causes of this decline and to develop management plans to counteract it. Crucial to these plans is a knowledge of how populations of migrant birds may be subdivided in both their breeding and wintering habitats. In this project we are using two recently-developed technologies, DNA marker and stable-isotope analyses, to investigate levels of subdivision of migrant bird populations in their breeding and wintering habitats. Over a four year period (1993-1997) this study will use blood and feather samples collected by University and Canadian Wildlife Service personnel from both temperate and tropical sample sites to 1) develop and assess the usefulness of a number of DNA marker systems and stable-isotope profiles for the delineation of wild bird populations and 2) use these markers and profiles to provide information on the extent of subdivision in five "indicator" migrant species chosen to represent this group of birds as a whole in Canada and in the tropics. QUBS was chosen as a sampling site for three of the species under study: Yellow Warbler (*Dendroica petechia*), Ovenbird (*Seiurus aurocapillus*) and American Redstart (*Setophaga ruticilla*) and blood and feather samples from breeding individuals of each of these species were collected in habitats around the station in the past year. Analyses of both genetic and isotopic variation in these samples is currently ongoing.

Assistant: Lorie Collins

Melanie Prosser - "Reproductive behaviour in Water Snakes - multiple mating by females and correlates of mate reproductive success" - PhD Thesis (co-supervised by Dr. Pat Weatherhead - Carleton)

Sexual Selection theory predicts that in most species, males should mate with as many females as possible, since the benefit of doing so (more offspring) outweighs the cost (expenditure of sperm). Reproductive success in males is affected by the number of females that a male can inseminate and should be much more variable than in females. In contrast, multiple mating should be costly to females

as the number of offspring they can produce is limited by the number of eggs they can generate. In many taxa, females receive enough sperm to fertilize all of their eggs from one copulation, yet they tend to mate multiply. I wish to study two wild populations and a captive-bred population of the Northern Water Snake, *Nerodia sipedon*, to:

- 1) determine whether there are any morphological or behavioural correlates of male reproductive success.
- 2) determine the incidence of multiple paternity in clutches born to females of the wild populations
- 3) investigate some of the proposed hypotheses regarding potential benefits of female multiple mating.

Parentage of litters will be assigned using hypervariable single-locus probes.

Assistant: Perry Comm

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

"Evolutionary and behavioural ecology of fish reproduction"

My research group continues its research on reproductive strategies in fishes. We are studying questions about mating systems, parental care and life histories.

The focus of our work in 1995 was twofold: DNA fingerprinting analyses, supervised by Bryan Neff, of the samples collected over the previous summers at Opinicon from bluegill colonies, to measure rates of cuckoldry; and, FA, parasite and condition analyses, supervised by Joe Justus, of mature and immature pumpkinseed collected over previous summers. This work was done primarily in our lab at Toronto. Mart spent a brief time at the Station and collected additional fish for the DNA fingerprinting.

Luca Cargnelli defended his M.Sc. thesis in June 1995 on: "Male Reproductive Behaviour and Recruitment in Bluegill Sunfish", and is working as a Research Assistant for Mart at the U of T. Joe Justus defended his M.Sc. thesis in September 1995 on: "Sexual Selection and Fluctuating Asymmetry in a Condition-Dependent Fish Ornament", and is now pursuing his Ph.D. with an NSERC Scholarship. Bryan Neff completed his B.Sc. in May 1995 and is now pursuing his Ph.D. with an NSERC scholarship. Joe and Bryan will be working at QUBS in 1996.

**Dr. David P. Philipp** - Center for Aquatic Ecology, Illinois Natural History Survey

Dr. David P. Philipp, Julie Claussen and Dr. John Epifanio - Department of Fish and Wildlife, Michigan State University, East Lansing, Michigan

"Natural hybridization events between bluegill and pumpkinseed"

Bluegill and pumpkinseed are common species of sunfish found in Lake Opinicon. Although these two species have similarities in their reproductive activities, as well as in their habitat requirements for building nests, they have clear morphological differences. Even so, natural interspecific hybridization readily occurs in the wild. Research in our laboratory has shown that this is accomplished when small sneaker male bluegill steal fertilizations from spawning pairs of pumpkinseed. To determine the relative fitness of hybrids we are sampling nests of males and determining the parentage of the offspring. The results of these analyses will allow us to assess the relative costs and

benefits of these hybridization events.

Assistant: David B. F. Philipp

**Dr. David P. Philipp, Dr. C. Anna Toline**, Dept. of Fish and Wildlife, Utah State University, Logan, Utah and **Frank Phelan**, QUBS

1. "Catch and release angling of Largemouth and Smallmouth Bass"

To measure the impacts of pre-season catch-and-release angling on the reproductive success of largemouth and smallmouth bass, researchers angled parental males of both species off their nest sites and determined the time it took to return, as well as the level of brood predation and subsequent abandonment rates. During the angling, aspects of handling and release, such as time in the boat, distance from the nest, etc. were varied to assess their importance for minimizing negative effects. In addition, as an initial step in modelling these impacts, experiments to determine average catch rates of nesting bass were conducted at various sites.

Assistants: Todd Kassler, Cory Suski, Dave Bell

2. "Spawning dynamics of Largemouth and Smallmouth Bass"

Little is known about the spawning dynamics of largemouth and smallmouth bass within a season and among years. To monitor mating and reproductive success of individual males of both species and their movements in appropriate habitat (lentic for LMB and lotic for SMB), nesting and non-nesting fish were caught, weighed, measured, fin-clipped, and tagged to identify location, and released at the point of capture. Data on mating success and success of raising their brood were taken. Within year movements and among year spawning location are being assessed.

Assistants: Todd Kassler, Vince Tranquilli, Heather Ferguson.

3. "Largemouth and Smallmouth Bass reproductive success"

This long-term study concentrates on documenting the annual variation in largemouth and smallmouth bass reproductive success. Intensive monitoring of spawning success and the duration of nesting and parental care behaviours in both species continued to be documented at Lakes Opinicon and Charleston, and at the Mississippi and St. Lawrence Rivers. This research is supported by the Ontario Ministry of Natural Resources, Queen's University and the Ontario Federation of Anglers and Hunters.

Assistants: Cory Suski, Heather Ferguson, Todd Kassler.

Publications:

Kieffer, J.D., M. Kubacki, F.J.S. Phelan, D.P. Philipp and B.L. Tufts. 1995. Effects of catch-and-release angling on nesting male smallmouth bass. *Trans. Amer. Fish. Soc.* 124(1):70-76.

Fox, M. G., Claussen, J. E. and Philipp, D. P. 1996. Geographic pattern in life history and genetic variation in pumpkinseed (*Lepomis gibbosus*) populations from four east-central Ontario watersheds. (Submitted to *North American Journal of Fisheries Management*).

Philipp, D. P., Toline, C. A., Philipp, D. B. F. and Phelan, F. P. 1996. The impact of catch-and-release



angling on the reproductive success of smallmouth bass. (Submitted to North American Journal of Fisheries Management).

Drake, M. T., Periera, D. L., Claussen, J. E. and Phillipp, D. P. 1996. A comparison of bluegill growth and reproductive strategies among lakes with different fishing intensities. (Submitted to North American Journal of Fisheries Management).

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

#### "Water mite parasitism of aquatic insects"

##### I. Reproductive isolation between species within sibling species pairs

In previous research at QUBS I had discovered what appeared to be two pairs of sibling species in which one sibling species has females that lay small eggs that result in parasitic larvae while females of the other sibling species produce large eggs that result in larvae that forgo feeding and any association with a host. In 1993, Seth Ettenberg and I began testing for reproductive isolation within sibling pairs. Larvae resulting from the cross between females from the lineage with parasitic larvae and males from the lineage with nonfeeding larvae had weak sclerotization and short leg segments typical of a non-feeding larva, yet needed a host: after numerous trials, only one or two individuals successfully matured from each of the sibling species pairs. However, there was no reduced viability among progeny from the reciprocal cross. We concluded that apparent asymmetrical success in development to adult represents partial reproductive isolation between species within each sibling species pair. In 1995 I concluded breeding experiments, producing an F2 generation and F1 backcrosses. There was no apparent reduction in viability beyond the F1 generation. Eggs resulting from all crosses were measured, and larvae, deutonymphs, and adult males and females were preserved for detailed morphometric comparison, which is in progress.

##### II. Population genetic consequences of dispersal via insects in the water mite genus and systematics of *Arrenurus* - Andrew J. Bohonak, Cornell University, and Dr. Bruce P. Smith, Ithaca College.

Nearly all water mite larvae are parasitic on aquatic insect adults. Certain species of *Arrenurus* parasitize dragonflies while other species will specialize on mosquitoes or on midges, with the hosts serving as a source of food and as vectors of dispersal. Some species of *Arrenurus* even forgo parasitism (and host-association) entirely. Dispersal should depend on whether the larvae are parasitic, the vagility of the predominant host species, and the average number of mites transported per host. We predict that the type of host-parasite association will have a substantial effect on the scale of genetic differentiation. Allozyme analysis of two *Arrenurus* sister species shows that population genetics does correspond to dispersal. For 5 polymorphic allozymes, heterozygosity is higher in the mosquito-dispersed *Arrenurus angustilimbatus* than in *Arrenurus rufopyriformis* (which lacks host-mediated dispersal). Also, population differentiation is higher in *Arrenurus rufopyriformis*, corresponding to drift-migration expectations for neutral alleles. We hope to continue screening more *Arrenurus* species in 1996 to see if these patterns hold across the genus.

##### III. Inter- and intrapopulation morphological variation in mites with and without host-mediated dispersal - Melissa Thornton, Ithaca College.

*Arrenurus angustilimbatus* and *Arrenurus rufopyriformis* show some reduced viability among F1 hybrids and can be considered either newly-diverged species or incipient species. While adults are cryptically similar, the former has larvae parasitic on mosquitoes while the latter produces larvae that forgo feeding and any association with hosts. For *A. rufopyriformis* to forego larval feeding, the

female produces extremely large eggs which is reflected by the extremely large size of her gonopore. Given that both species inhabit temporary woodland pools that are isolated from one another, probably the only exchange of individuals among populations is through host-mediated dispersal. The prediction is that there will be much greater interpopulation variation in morphology among *A. rufopyriformis* (lacking host-mediated dispersal) when compared to *A. angustilimbatus* (having host-mediated dispersal). Adults of both species were collected by Andy Bohonak from a number of different ponds in Algonquin Park and in the region between QUBS and Ottawa. Body length and width of males and females, as well as female gonopore length and width, were measured for adults from 5 *A. rufopyriformis* sites and 7 *A. angustilimbatus* sites. The diameter was measured for eggs obtained from field-collected females maintained in the laboratory, and resultant larvae were collected for morphometric analysis. The data confirmed the hypothesis: *A. angustilimbatus* populations were homogeneous for the parameters measured, with no significant variation among populations, while there was large and statistically significant variation among *A. rufopyriformis* populations for almost all parameters measured. The only exception was the size of the female gonopore, which did not vary among populations and appears to be the most reliable and consistent distinction between the two species.

**Dr. Patrick Weatherhead** - Department of Biology, Carleton University, Ottawa, Ontario

#### "Long-term studies of red-winged blackbirds and black rat snakes"

In 1995 the long-term studies of red-winged blackbirds (17 years) and black rat snakes (15 years) were continued. The only new initiative in this work in 1995 was a small radio-telemetry study of black rat snakes undertaken to locate new hibernacula in undisturbed areas on QUBS property. Four rat snakes captured at scattered locations had radio transmitters surgically implanted and were tracked until they went underground in October. Each of the snakes went to a different (and previously unknown) hibernaculum, thereby setting the stage for a detailed telemetry study of black rat snakes in habitat with minimal human impact.

Assistants: Blackbirds - Kevin Dufour, Kit Muma  
Rat snakes - Perry Comm, Greg Brown (surgery by Dr. Cathy Shilton)

#### "Censusing and monitoring amphibian populations"

Evidence accumulated over the past decade suggests that amphibian populations may be declining globally. One consequence of identifying this problem has been the recognition that we have very few reliable, long-term population data that are necessary to confirm that the perceived declines are real and different from natural population fluctuations. The property acquired by QUBS over the past two decades is ideal for establishing a long-term amphibian monitoring program because of the abundant and varied wetlands, and the realistic expectation that this land will remain undeveloped. In 1995 we conducted initial amphibian surveys at 23 different sites on QUBS property. Through funding from Parks Canada, one goal of this research was to assess the merits of various census methods so uniform monitoring programs could be established at various locations in the national parks. Through funding from the Ontario Ministry of Natural Resources, a second goal of this research was to assess the impact of harvesting on bullfrogs, a species which until this year was still harvested under commercial licences for human consumption. Analysis of the data is currently underway.

Assistants: Dave Bell, Shawn Reed

Greg Brown - "Thermal ecology, growth and mating behaviour in the northern water snake" - Ph.D. Thesis

The goal of my research is to investigate factors affecting the growth of water snakes in order to interpret an apparent paradox in their sexual size dimorphism. Males physically compete with one another for access to mates, but they are much smaller than females. In 1995, we continued a long-term mark-recapture study of water snakes in Beaver and Barb's marshes. In order to elucidate the effect of male body size on reproductive success we continued to observe the mating activity of individual snakes in the wild. We supplemented these data with detailed observations from mating trials conducted in the lab under controlled conditions. Several females from the study populations were captured in August and maintained in the lab until they gave birth. Blood samples were collected from the offspring for future analysis of paternity. Intensive radio-telemetry was carried out to continuously monitor the body temperatures of free-ranging snakes in order to determine the extent to which the snake's thermoregulation is constrained by the climate and the extent to which variation in body temperature affects growth. A sample of radio-tagged were supplementally-fed at regular intervals to determine how extra resources would affect their temperature selection, growth and activity.

Assistant: Perry Comm

Melanie Prosser - "Male mating success relative to sexual size dimorphism in northern water snakes" - PhD Thesis (co-supervised by Dr. H. Lisle Gibbs, McMaster University).

The use of DNA-based techniques to measure paternity has revolutionized the study of avian mating behaviour. These methods should be equally valuable for studies of snake breeding behaviour, particularly because of the greater difficulty of observing snake behaviour in the wild. Development of single-locus (microsatellite) probes for northern water snakes was completed in 1995 and these probes are currently being used to evaluate male mating success in broods produced both by females mated in captivity and in the wild. These data will be used to determine the effect of mating order and body size differences on male success, as part of the general goal of understanding how sexual selection operates in this species.

Assistant: Perry Comm

#### Publications:

- Montgomerie, R. and P.J. Weatherhead. 1996. How robins find worms. *Anim. Behav.*, in press.
- Prior, K.A. and C.M. Shilton. 1996. Post-hibernation mortality in black rat snakes, *Elaphe o. obsoleta*. *J. Herpetol.*, in press.
- Prior, K.A. and P.J. Weatherhead. 1996. Habitat features of black rat snake hibernacula in Ontario. *J. Herpetol.*, in press.
- Scribner, S. and P.J. Weatherhead. 1995. Locomotory ability and predator avoidance in three species of semi-aquatic snakes. *Can. J. Zool.* 73: 321-329.
- Teather, K.L. and P. J. Weatherhead. 1995. The influence of age and access to females on dominance in captive male brown-headed cowbirds (*Molothrus ater*). *Can. J. Zool.* 73: 1012-1018.
- Weatherhead, P.J. 1994. Mixed mating strategies by females may strengthen the sexy son hypothesis. *Anim. Behav.* 47: 1210-1211.

Weatherhead, P.J. 1995. Effects on female reproductive success of familiarity and experience among male red-winged blackbirds. *Anim. Behav.* 49: 967-976.

Weatherhead, P.J., F.E. Barry, G.P. Brown and M.R.L. Forbes. 1995. Sex ratios, mating behavior and sexual size dimorphism of the northern water snake, *Nerodia sipedon*. *Behav. Ecol. Sociobiol.* 36: 303-311.

Weatherhead, P.J., K.J. Metz, D. Shutler, K.E. Muma and G.F. Bennett. 1995. Blood parasites and dominance in captive blackbirds. *J. Avian Biol.* 26: 121-123.

Weatherhead, P. J. and R. Montgomerie. 1995. Local resource competition and sex ratio variation in birds. *J. Avian Biol.* 26: 168-171.

Yezerinac, S.M. and P.J. Weatherhead. 1995. Plumage coloration, differential attraction of vectors, and haematocrit infections in birds. *J. Anim. Ecol.* 66: 528-537.

Yezerinac, S.M., P.J. Weatherhead and P.T. Boag. 1995. Extra-pair paternity and the opportunity for selection in a socially monogamous bird (*Dendroica petechia*). *Behav. Ecol. Sociobiol.* 37: 179-188.

Yezerinac, S.M., P.J. Weatherhead and P.T. Boag. 1996. Cuckoldry and the absence of parentage-dependent parental care in male yellow warblers. *Anim. Behav.*, in press.

#### Theses:

- Comm, P. 1995. Mating behaviour of captive northern water snakes. B.Sc. Thesis.
- Yezerinac, S.M. 1995. Extra-pair mating in yellow warblers: sexual selection and reproductive strategies. Ph.D. Thesis.



*Summary of Conference, Meeting and Field Trip Use of QUBS in 1995*

Organizer	Function	Number of Participants	Duration
Kelvin Conrad (Queen's - Biology)	Reunion Weekend	28	Jan. 21-22
Dr. R. Harmsen (Queen's - Biology)	Bio 528 (Population Ecology) Weekend	14	Jan. 27-29
Diane Warren (CLAHS)	Chaffey's Lock and Area Heritage Society Board Meeting	8	Feb. 7
Lisa Shea (Queen's - QPID)	Queen's Program in International Development Weekend	26	Mar. 10-11
Jim Atack (RVFN)	Rideau Valley Field Naturalists Meeting and Field Trip	16	June 4
Steve Thompson (Sir Sandford Fleming)	Terrain and Water Resources Field School	10	June 13-16
Caroline Benedek (Queen's)	Science Discovery Staff Orientation Weekend	8	June 23-25
Caroline Benedek (Queen's)	Science Discovery Field Trip	30	July 6
Doug Kirkland (RWLT)	Rideau Waterway Land Trust Board Meeting	6	July 6
Caroline Benedek (Queen's)	Science Discovery Field Trip	28	July 20
Caroline Benedek (Queen's)	Science Discovery Field Trip	28	Aug. 3
Caroline Benedek (Queen's)	Science Discovery Field Trip	28	Aug. 17
Steve Thompson (Sir Sandford Fleming)	Terrain and Water Resources Fall Field School	39	Sept. 11-15
Jim Bogart (U. of Guelph - Zoology)	Herpetology Weekend	30	Sept. 15-17
Brian Barkley (Manager, EOMF)	Eastern Ontario Model Forest Project Leaders Tour	13	Sept. 20
Vicki Remenda (Queen's - Geology)	Hydrogeology Weekend	91	Sept. 22-24
Julian Szeicz (Queen's - Geography)	Geography Field Trip	32	Sept. 24

Organizer	Function	Number of Participants	Duration
Lonnie Aarssen (Queen's - Biology)	Ecology 302 Weekend Group 1		Sept. 30- Oct. 1
Brian Cumming (Queen's - Biology)	Limnology Weekend		Sept. 30- Oct. 1
Lonnie Aarssen (Queen's - Biology)	Ecology 302 Weekend Group 2		Oct. 14-15
Steve Thompson (Sir Sandford Fleming)	Terrain and Water Resources Field School	41	Oct. 23-27
Anne Robertson (Kingston Field Naturalists)	Junior Kingston Field Naturalists Field Trip	8	Nov. 4-5

*Documentation of Use of QUBS in 1995 - User-Days*

User	Supervisor	Post-Doc	Graduate Student	Assistant	TOTAL
<b>INTERNAL (QUEEN'S) RESEARCH</b>					
Aarssen	18	0	2	190	210
Briskie	1	0	0	0	1
Crowder	6	0	0	0	6
Eckert	21	0	0	110	131
Harmsen	45	0	120	113	278
Keast	47	0	0	0	47
Leggett	0	3	0	1	4
Lougheed	0	0	0	2	2
Montgomerie	6	0	12	0	18
Phelan	n/a	0	0	116	116
Proctor	59	0	181	107	347
Ratcliffe	5	0	146	80	231
Robertson	64	124	243	559	990
Smol	0	0	0	9	9
Tinline	0	0	81	75	156
Tufts	0	0	39	0	39
<b>Total Internal</b>	<b>272</b>	<b>127</b>	<b>824</b>	<b>1362</b>	<b>2585</b>
<b>EXTERNAL RESEARCH</b>					
<b>University of Toronto</b>					
Fullard	77	0	0	114	191
Gross	4	0	0	0	4
<b>Carleton University</b>					
Weatherhead	50	0	215	424	689
Forbes	65	0	177	7	249
<b>Illinois Natural History Survey</b>					
Philipp	72	0	0	70	142
<b>University of Guelph</b>					
Bogart	2	0	234	2	238
<b>Ithaca College</b>					
Smith	87	0	0	70	157
<b>Trent University</b>					
Fox	3	0	9	6	18
<b>Utah State University</b>					
Toline	72	0	0	15	87
<b>Michigan State</b>					
Epifanio	10	0	0	0	10
<b>McMaster University</b>					
Gibbs	2	0	73	14	89
<b>Cornell University</b>					
Bohonak	0	0	31	0	31



*Documentation of Use of QUBS in 1995 - User-Days (continued)*

User	Supervisor	Post-Doc	Graduate Student	Assistant	TOTAL
SUNY - Binghamton Arendt	0	0	2	0	2
Total External	444	0	741	722	1907
Total Research User-Days	716	127	1565	2084	4492
% Queen's	38	100	53	65	58
% Non - Queen's	62	0	47	35	42

USER-DAYS IN TEACHING ACTIVITIES 2628

CONFERENCE AND FIELD TRIP USE 665

OTHER\* 1110

GRAND TOTAL USER-DAYS IN 1995 8895\*\*

(\* QUBS staff, family and their visitors are not included)

(\*\* up 10% from 1994)

*Seminars 1995*

- May 26 Dr. Ian McLean - University of Canterbury, New Zealand  
"Conservation in Saudi Arabia"
- May 30 Henry Lickers - Mohawks of Akwesasne  
"Native American Perspectives in Conservation"
- May 31 Dr. J. Allen Keast - Department of Biology, Queen's University  
"The South Pacific: Biogeography and Conservation Issues"
- July 5 Shane McCloskey - Department of Biology, Queen's University  
"How to succeed in a forest without really trying: The structural indicators of forest succession"
- July 12 Vicky Boomgaardt - Department of Biology, Queen's University  
"I heard the treeswallow call my name: An examination of tree swallow song"
- Catherine Oliarnyk - Department of Biology, Queen's University  
"If a tree falls in the forest, does any birdy rear?: Effects of forest thinning on the reproductive success of Cerulean Warblers"
- Clive Goodinson - Department of Biology, Queen's University  
"How to come glean and eat like a Cerulean"
- July 20 Turid Forsyth  
"Drawing from Nature: the artist's portfolio"
- July 24 Dr. John Confer - Ithaca College  
"Fifteen years with the Golden-winged Warbler: Competition, hybridization and habitat loss"
- August 17 Dr. James Fullard - Erindale College of University of Toronto  
"Bats: Behavior, ecology and conservation"

## *Fee Schedule for 1996*

### Board Charges - Meals only

\$430/month/person	-no obligation for chores
\$300/month/person	-includes obligation for chores on a rotating schedule

### Accommodation Charges - Housing only

\$16.50/month/person	-dormitory (White House or Curran Cottage)
\$33/month/person	-small cabin
\$66/month/person	-medium cabin (Cabins 3, 8, 9, 10, 14)
\$88/month/person	-large cabin (Cabins 12, 15 and White House Apartment)
\$121/month/person	-Cottage (Keast, Earl, Sumac or Maplewood)

### Room and Board Rates for Short-term Visitors

\$180/person	-weekly R&B for field courses - includes a lab fee
\$22/day/person	-24 hr. room and board
\$4.00	-breakfast or lunch only
\$7.50	-dinner only
\$9.00/person	-overnight accommodation - academic purposes
\$19/person	-overnight accommodation - non-academic purposes

**NOTE** - Fees for groups and conferences are negotiated directly with the Manager or Director

### Boat Rental

\$200/month, \$90/week - includes maintenance from normal use - gas and oil not included

\$40/day - includes gas and oil for one day rental

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

### Bench Fees

\$4.65/day - non-Queen's staff or major researcher (M.Sc. or Ph.D. candidate, project coordinator or Post-Doctoral Fellow)

\$1.60/day - each non-Queen's assistant

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

### 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, direct sales (e.g. equipment) and all charges for room and board from casual users.