

# *Queen's University Biological Station*

## *Annual Report and Newsletter*

**1994**



*Director: Dr. Raleigh J. Robertson*

*Manager: Frank J.S. Phelan*

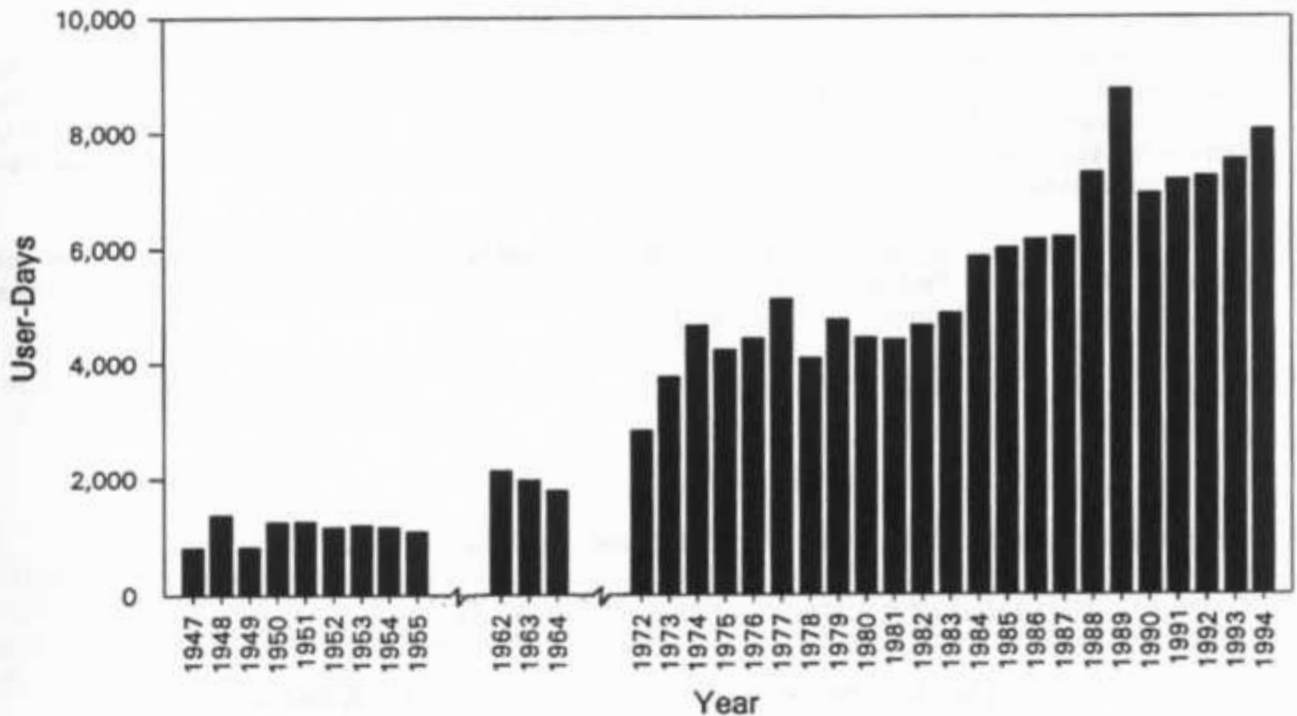
## Introduction

Nineteen ninety-four was another successful and busy year at Queen's University Biological Station. The year was highlighted by the dedication of the "Hilda and John B. Pangman Conservation Reserve", the aquisition of which was made possible by a very generous gift to Queen's University from Mrs. Hilda Pangman. It was a productive year for both research and teaching, with a seven percent increase in user days from 1993 levels (User-day data are displayed in tabular form later in this report. On average, 32 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 twelve modules in the Ontario Universities Program in Field Biology. Seven of these were presented by Queen's faculty, five 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 fall, Steve Thompson (Sir Sandford Fleming) brought his Terrain and Water Resources Field Course to QUBS. The sixteenth edition of the Naturalists' Workshop, described in more detail later in this report, was held in late May.

Over the time of existence of the field station, use of QUBS has been steadily increasing. Frank went back through old files and assembled user-day data for as many years as possible. The very old estimates (1947 through 1964) were derived from budgetary files. There are some years for which only sketchy records exist. These have been excluded from the figure below.

User-Days at Queen's University Biological Station



Comparing 1984 levels with 1994 levels, overall use has increased by 37%. With the exception of 1989, growth has been steady over the past decade.

The demand for small conferences, meetings and workshops continues to grow. QUBS is able to host several of these events each year. 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 1994 appears later in this report.

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

In an effort to acquire a 1500-acre tract of forests and wetlands, encompassing 6 lakes, the popular Lindsay Lake Road nature trail, and some prime breeding habitat for the endangered Cerulean Warbler, we set out in late 1993 to raise the \$540,000 necessary to purchase this important area from the Rock Lake Association. With the expert and enthusiastic help of Charles Sauriol, we developed a brief entitled "The Back Lakes - A Conservation Reserve for Warblers and Wetlands, Science and Education" which explained the values of this area for teaching, research and conservation.

We are extremely grateful that Mrs. Hilda Pangman made a very generous donation, in the amount of the full purchase price, to enable Queen's to acquire this valuable conservation reserve. Mrs. Pangman made this donation in honour of her husband, who appreciated birds, nature and the conservation values that are embodied in this diverse natural area.

To celebrate the donation and to dedicate the property, a ceremony was held in July at the field station. Some 200 guests, regulars and friends of the station turned out on a warm summer's day to participate in the event. The Pangmans (Mrs. Hilda Pangman, son Peter Pangman and Peter's wife Ann) were treated to an aerial tour of the property by helicopter. We thank Mr. Michael Davies and his wife Elaine for their hospitality and the magnificent opportunity to appreciate the extent of the property from the air.

Under a tent erected on the lawn in front of the lodge, the property was dedicated. On the following pages, we reproduce the text of the speeches made during the ceremony. These remarks, by a cross-section of Queen's faculty, students, and administration, plus Mr. Charles Sauriol, help to convey the significance of this area to Queen's, and the appreciation that we extend to Mrs. Pangman for her generosity and her commitment to conservation.

The ceremony was followed by a luncheon, prepared with care by the field station's staff and regulars. After lunch, Paul Martin, Catherine Oliarnyk, Bruce Smith and Floyd Connor led a hike through some of the Pangman Conservation Reserve.

### *Programme*

#### *Dedication of the Hilda and John B. Pangman Conservation Reserve*

#### *Queen's University Biological Station - Lake Opinicon*

*11:30 A.M. on Friday, July 15, 1994*



Pangman Dedication - Dr. David Turpin and Mrs. Hilda Pangman after unveiling the plaque

### *Text of Addresses during Pangman Dedication - July 15, 1994*

**Dr. Raleigh J. Robertson**  
Professor of Biology and Director  
Queen's University Biological Station

Welcome!

The purpose of this dedication ceremony is two-fold: The first purpose is to commemorate this important occasion, of Queen's University acquiring a large area of land, with a diversity of natural habitats, and to dedicate that land to conservation, education and research purposes. The second purpose is to express our gratitude to Mrs. Hilda Pangman, for the magnificent gift to Queen's which has made this acquisition possible.

For those of us who do research and teach here at the Queen's Biological Station, the Back Lakes Tract has been well known for many years. This area encompasses a great variety of habitats, including six lakes, a large wetland complex, some successional farmland that was abandoned some 40 years ago, and extensive areas of mixed deciduous forest. The area is traversed by the Lindsay



Lake Road, a very primitive road but excellent hiking trail, that winds through a diversity of habitats. Because of this diversity, the Lindsay Lake Road has been a favoured area for bird observation and study over the past decade.

The Rock Lake Association, the former owners of this land, have been most cooperative in granting us access to this and their other properties in the past, and for that we would like to express our appreciation. (Several members of the association are here today, including President Frank & Mrs Hilburger, and Secretary-Treasurer Dean Whipple, and Sarah Whipple, also Jim Hilburger & Jack Martinke). The RLA have been excellent stewards of this land for the past 25 years. The land has remained largely undisturbed which has contributed to its value as a conservation reserve. The RLA should be commended for the care shown for their natural environment.

Today, we will dedicate this tract of 1500 acres to conservation, and to teaching and research. The area is important as a conservation reserve because it encompasses a great diversity of habitats and life forms, and especially because it includes large areas of breeding habitat for the Cerulean Warbler. The Cerulean Warbler is one of our migrant songbirds which has suffered a severe decline in numbers during the past 30 years, and which has recently been put on the endangered species list. The area is important for teaching and research because it provides extensive areas in which students and researchers can observe and study a great variety of plants and animals in their natural environment. As population and development pressures grow, it is becoming ever more important to develop a better understanding of the structure and function of natural communities and ecosystems, so that we are in a better position to avoid environmental problems in the future, and to solve those problems which we have already created.

I could go on at length about the features of this land, and the importance of the land to QUBS and to conservation. However, I have asked a number of people to join me in this dedication, and they will each focus on some aspect of the land, and on the programs that it will enhance. Before introducing our other speakers, however, I want to acknowledge Mrs. Pangman.

I would like to thank Mrs. Hilda Pangman for a very wonderful gift to Queen's and to the Biological Station. On behalf of the faculty and students who use this field station as a base for either research or teaching, I want to say that we are extremely grateful. I find it very difficult to convey the extent of the appreciation that so many of us feel because of this very important contribution to Queen's and to conservation. I hope that you will get a great deal of satisfaction out of the knowledge that the value of this gift will actually increase through the years. As surrounding areas become more populated and developed, this reserve will become more and more valuable, and will take on a greater importance for both Queen's and for conservation. For decades - hopefully centuries - to come, Queen's students will have easy access to an example of unspoiled nature in which to conduct their studies.

I would like to recognize Mrs. Pangman's son, Peter, and his wife Ann. I also extend our appreciation to them for the interest in nature and the commitment to conservation which they share with Mrs. Pangman.

It is now my pleasure to introduce the Vice-Principal of Resources at Queen's University, Dr. Rod Fraser. As many of you know Dr. Fraser has recently announced that he will be moving to Edmonton to become the President of the University of Alberta. We will miss him. I am especially pleased that Rod is here today because it gives me a chance to thank him for the tremendous support he has given the Biology Station through the years, first as Dean of Arts and Science, and more recently as the Vice-Principal of Resources. He has been an extremely helpful and encouraging Vice-Principal and we're really grateful for that help. At the same time I would also like to acknowledge someone who works in Rod's office, but unfortunately couldn't be here today: Dee Wilson has helped with the logistics of many of our proposals and acquisitions. We have received a lot of help from Rod's office and we are very grateful for that.

Dr. Rod Fraser  
Vice-Principal (Resources)  
Queen's University

Thank you very much, Raleigh, for your generous introduction. Wearing the hat of a Vice-Principal of Resources, it is indeed a pleasure to be able to take part in a celebration such as we are having today.

Principal Smith and Principal-elect Bill Leggett are unable to be here but they have asked me to extend their best wishes to us today as we celebrate this event; and to you Mrs. Pangman and your family they extend their sincere appreciation for your generous and thoughtful gift.

Thus, on behalf of Queen's University, I would like to express our gratitude to you and your family for a gift that has allowed the acquisition of the property that will serve those multiple ends of conservation, teaching and research. Through your gift you have demonstrated the ultimate commitment to conservation. Our Cerulean Warbler will indeed live on, in more than the china reproduction.

At the same time, you have contributed enormously to the opportunities that countless generations of Queen's students, staff and faculty will have at the Biology Station.

The Queen's University Biological Station plays an integral and active role in the teaching and research programs of the Department of Biology. The Biology Department at Queen's is currently undergoing a major expansion, with the building of a major Biosciences Complex. The development of the Environmental Studies Program, which will increase societal and student demand for our programs, has meant that we did indeed want to take a leadership role in the development of our Biology Department. Thus, your gift allows us to move forward so much more rapidly, in what is already a first class Biology Department, towards our goals for our students and broader society.

The Biological Station, with the addition of the Hilda and John B. Pangman Conservation Reserve, makes Queen's the home of the largest wholly-owned inland Biological Station in Canada, and one of the largest in North America. Experience has shown that ownership of land for use as study sites for ecological research provides important security for both long- and short-term studies. Ownership of the land ensures that studies will not be threatened by outside disturbances and by changing land-use practices. This land ownership also allows the university to establish an important conservation area for Ontario.

The availability of extensive and diverse natural habitats in this new conservation reserve, and in the adjacent tracts, provides the Opinicon Station with excellent opportunities for hosting undergraduate and graduate programs. The addition of this very significant natural area leaves the Station in an excellent position to expand other aspects of its program, and to respond to the growing need to teach young Canadians how to best care for our natural environment.

Thus, Mrs. Pangman, to you and your family we express our deep appreciation for your generous gift of the living laboratory.

**Dr. Raleigh Robertson:** It is now my pleasure to introduce Dr. Adele Crowder. Adele is a professor of Biology. Adele and I have worked together for more than twenty years teaching ecology courses and she has made an important contribution to the field station. I think Adele is really the person who got me interested and motivated to try and acquire the Hughson Tract back in the mid '70's. So many of our land acquisitions have grown from that and she really played a central role. Adele has had a long-term involvement in a program here at the field station known at the Naturalists Workshop and one of the places the Naturalists Workshop always goes is the Lindsay Road and walk back to Lindsay Lake. Today Adele is going to talk to us about that program and what the Back Lakes means to her.

**Dr. Adele Crowder**  
Professor of Biology  
Queen's University

About sixteen years ago we realized there was an enormous number of people who wanted to come to field courses here but couldn't because they weren't students and they didn't qualify and so we then started running what we call workshops and that was the beginning of the Naturalist Workshop. We have one big workshop early summer and sometimes short ones as well. The purposes are two:

First of all, to get people who are at the workshop to exchange their information and expertise on how to identify everything from vultures to bobcats, and to nematodes and plants and the people who come have enormous expertise.

The second purpose is to study those organisms (all of them) in their ecosystems so we tend to visit one ecosystem at a time and this is where the Back Lakes Tract has been absolutely wonderful for us. As Raleigh says, we can be guaranteed to see more diversity of birds in half an hour than in two days of driving around the countryside. It is wonderful.

The workshops are run on the goodwill of the University faculty not just from Queen's, even Alberta or whatever, and in fact I think we can outdo Alberta. We've had participants who have come from the States and Europe. So it is just a little bit bigger. It is not entirely a serious affair. There is nothing funnier than watching one's colleagues rolling in poison ivy while Raleigh directs them to look at birds up here, and they fall over. And that has happened, but I think that workshop participants have been useful contacts for the university. They have broadened our contacts in the neighbourhood and mainly with Parks: both National parks and Provincial Parks, Conservation Authorities and various teachers of ecology throughout the province. We get about 18 people a year, so the contact spreads all the time.

I just want to add one other thing: All that area was forested and lumbered about 120 years ago. The threshold value for old growth forest for most species is about 120 years. So when we say this is going to increase in value and interest, we are looking at the beginning of a marvellous old growth forest. The provincial committee which is developing a conservation strategy for old growth forest has appreciated that the only way you can preserve them is by landscape management on an enormously big scale because they shift about. The forests will shift on the landscape and we now have appropriate scale. This is absolutely wonderful, so thank you again.

**Dr. Raleigh Robertson:** Now I would like to introduce Dr. Allen Keast. Dr. Keast has been a very longtime user of the Biology Station - he has been working here since the mid '60's. During that time he's undertaken very important studies on fish communities and at the same time, on a global level, he kept an interest and involvement in bird community structures. In a book that he wrote with Eugene Morton from the Smithsonian Institution on migrant birds in the neotropics he helped to increase both public and scientific awareness about the plight of some neotropical migrants. Today I would like to have Dr. Keast address us and discuss some of the importance of this conservation reserve especially for the Cerulean Warbler.

**Dr. J. Allen Keast**  
Professor of Biology  
Queen's University

Thank you very much. To me as a thirty-year resident, researcher and naturalist, the acquisition of this vast new tract of original habitat with its remarkable diversity is meaningful indeed.

I first was introduced to Lake Opinicon in 1960 when I was interviewed for a job. I stood on the

shoreline here and gazed over this remarkable body of water with its clear images and the calls of loons bouncing off the shore and herons floating overhead and watching the fish of various kinds in the water. This, of course, initiated a series of studies with a range of graduate students and undergraduates. We have had a diversity of courses and simply hundreds of students down through the years have passed through here and, as my colleagues and I know, it is a bit flattering at the end of a course to get a letter from a student saying that they've changed their attitude to wildlife and that they've had a memorable time.

Of course lately the world has been under increasing challenge and from a habitat viewpoint I've been interested in migrating birds. We have a marvellous breeding area with a wide range of migrant species here. We have, in Central America, been increasingly depressed at the loss of habitat and wondering what's happening to many of the species. In the U.S., the forests have fragmented to the extent that nest predators and parasites like cowbirds are common so that native species are under challenge and threat. But here, with this vast new tract of land, they are immune and largely safeguarded from these peripheral edge predators like jays and so on. It has been brought out increasingly that their success depends on the existence of a considerable area.

The people who have gone through here at the field station include some of the leading research biologists in Canada. These people have gone abroad and made an impact on conservation. This new addition will certainly further this cause. Just in recent weeks Floyd Connor and I went around to some of the Back Lakes and I was able to rejuvenate my initial impressions with such a diversity of lakes, small deep ones, wider ones, beaver ponds, and so on. You can just see the different species of fish in the shallows. I stood there gazing over these waters, treeline and shoreline and said, "We are lucky!". I hope that as researchers at Queen's we can justify the confidence that the donors have placed in us.

Thank you.

**Dr. Raleigh Robertson:** Now, it's my pleasure to introduce Paul Martin. Paul is an undergraduate student in Biology at Queen's. He is an outstanding young ornithologist. Paul played a very important role in the decision to try to acquire the Back Lakes Tract. Last summer, while working on a project involving censusing of bird populations in forests with different management histories, as part of the Eastern Ontario Model Forest Project, Paul documented excellent populations of Cerulean Warblers on the Back Lakes Tract, and the adjacent Bonwill-Skycroft Tract. It was Paul who pointed out that this area encompasses what is probably Canada's best breeding habitat for Ceruleans. Paul's youthful enthusiasm, and his persistence in pointing out the importance of this area for conservation, were a major element in our decision to launch this project. I find it very gratifying that one of the major players in this project is a student in his early 20's, on the doorstep of what I am confident will be an exciting career in biological research, conservation and education.

**Mr. Paul Martin**  
Undergraduate Student in Biology  
Queen's University

I'm a 22 year old student of biology in my fourth year of undergraduate studies and have been privileged enough to have worked here at the biology station for the past four years. I entered biology through a fascination with birds and found myself here at the station, astounded by the area's rich flora and fauna. It was here that I came to know song birds weighing less than a dollar coin that migrate all the way from the foothills of the Peruvian Andes just to nest in the treetops of the Lake Opinicon region. It was here that I also came to understand that these little bundles of feathers and energy were far more complex than I could imagine. Their social system is so complex that they require large expanses of continuous forest. Without this forest we are without these birds. In my time at the station I've worked a great deal at the Back Lakes, as a field assistant, and an Honours



this student as well as helping with field courses and just generally exploring. For me and others around me this area was a window into the complexities of the plant and animal communities of the regions interacting to form the ecosystems that we see.

In my past four years I have had the opportunity not only to experience and learn much of what I know today from this area, but as well to see others, fellow students, young and old, do the same. To students, the protection of the Back Lakes will mean opportunities for the future and experiencing and appreciating learning first-hand biology of this area.

We have come to understand that large tracts of continuous forest are essential for the maintenance of viable wildlife populations. Thus with the protection of the Back Lakes we see protection of numerous populations of wildlife throughout the region on the broader scale. But the benefits from the conservation of the Back Lakes will extend even beyond the protection of this area itself. It provides us with an example of conservation at work. Most young people have developed a deep concern for the maintenance of natural populations of species and biodiversity. Today we are privileged to be witness to active conservation taking place, with critical habitat being preserved. For students like myself it is inspiring to see the dedication and commitment to conservation for generations to come by people like Mrs. Pangman, Dr. Robertson, Mr. Phelan, Mr. Sauriol and all those involved in the acquisition of this land. Thus the protection of the Back Lakes has and will provide inspiration both from the wonders of this incredible region and from the dedication and will of those who sought to protect it. While the area will remain much as it is today, it benefits the natural populations of the region. As well, contributions of students like myself will be affected by this area and will continue for many years to come. Thank you.

**Dr. Raleigh Robertson:** I think our future is in good hands! Another source of youthful enthusiasm for this project came from Charles Sauriol. It is my privilege to introduce him. Although he recently celebrated his 90th birthday, he confided in me the other day that he's reverted to being a youthful 70 year-old. Charles, as many of you know, has dedicated the past 40 years to raising money for conservation land acquisition, through the Nature Conservancy, the Metro Toronto Region Conservation Authority, and other Conservation Authorities in southern Ontario. In the past he has helped us for both the Bonwill-Skycroft Tract, and the John M. Cape - Charles Sauriol Environmental Studies Area. When I phoned Charles last August to describe the Back Lakes Tract, without a moment's hesitation he said he would be glad to help us. His enthusiasm for the project made me see that the project could succeed, and he was an invaluable contributor to its success. I consider the opportunity to work with Charles a great privilege. I'm pleased to have him here today, pleased that he is going to say a few words to us.

**Charles Sauriol, CM**  
Conservationist  
Toronto, Ontario

One of the very nice things about being at the end of the list is you find that most of what you were going to say has been said so all you really have to do is make a bow.

A week ago at this precise time my very valuable associate Lou Wise and I were 300 miles to the northwest of here celebrating the culmination of the Donnelly purchase which is 3100 acres in the Greenbank Wetlands. A ten year program has been successfully completed and we were to have a mortgage burning. There was a chap who strolled up dressed in Indian garb with a handful of faggots and a little bit of very fine tinder. He took the piece of flint and he took something that looked like a small horseshoe and he started doing this - like on a harp. Obviously he is going to get a spark. I just came to the point of seeing if anybody had a match when a little tiny bit of smoke curled up the tinder. More smoke! More smoke! He just threw it on the pile of faggots. Then, when the flames had got to a certain height, we threw in the facsimiles of the mortgages and burnt the mortgages for the Donnelly property.

Now, one tiny little spark - I never thought he could do it. There have been other sparks: not too long ago, about 20 years, somebody started the spark here and I didn't know it. But again, it's the old story of the great woman behind the great man. You (Dr. Crowder) were the spark. You were the spark. Of course you were. I often wondered who got the Hughson Tract together. I found out this morning. From then on it was success all the way. The Bonwills, dedicated people from Connecticut, were first and the Pangmans had been involved in a set of circumstances that don't call for explanation here, but it happened. Then Opinicon (Cape-Sauriol Tract) came along and dear Henry Wright said "I can't develop it, I just can't, but I have to pay off my associates", and as you will know, Raleigh, Opinicon came through at a very reasonable rate. I don't see why you ever put my name to it but you didn't have to, and then this. So there is the way these things are done. And everyone has said, what I might say, you cherish the value, you know that.

But things just don't happen. Mrs. Pangman will recall what she said to me a few years ago and you can quarrel with me after but I'm going to say some nice things: "Charles, I love this country and I want to do something for it". Now that's the basis of what everything is.

Mrs. Pangman and her late husband John Pangman are remarkable people. I know. Project after project after project in Ontario! Nothing will be said, nothing will be said! The hardest people to even put their names on it.

When I was writing Green Footsteps... You have to let me tell the story of what you've done at Green Footsteps... you've got a wonderful name, it's going to survive, because this is what you're all about. You're not running out of steam, you're running out of time. This is the encouraging thing, to know that we have found the path to nature. And I know how hard it is to raise money for anything, and you have led in a concept that if I have anything to do with it it's going to be followed by a lot of people across the country.

There comes a time when the most important thing is what's around us. The most important thing to all you people here today is the value of units of the natural terrain which must be kept for the future. It was more difficult for people to see that a generation ago than today. But it's beginning to find us, even in the river valleys and that great big throbbing metropolis of Toronto. The most important thing, as far as I'm concerned, was the greenbelt that is being won and its health which is very important too.

I am glad to be here. Raleigh and I are old friends. I owe him a lot of coffee at the corner donut shop and I want to tell you we are plotting together for bigger and better, whatever it is, but going in the right direction. Again, thank you very, very much.

**Dr. Raleigh Robertson:** Before introducing our last speaker, there are some other people who made very important contributions to this project that I want to acknowledge.

Foremost of these is Frank Phelan. Frank, as I'm sure all of you know is the manager here at the biology station and has been an enormous help in developing funding proposals and working with negotiations and all sorts of logistical details. Frank deserves lots of credit for all of the accomplishments that have been enjoyed here at the field station over the past 18 years that he has been Manager. So, thanks to Frank!

I would also like to acknowledge Floyd Connor. Floyd is the Assistant Manager here and Floyd, in conjunction with Naz MacDonald, has made very important contributions to increasing the awareness of nature, and of the biology station program through their organization called the Friends of Opinicon. We appreciate this effort of Floyd's and Naz's, and also we appreciate the support of these many "Friends" of Lake Opinicon and Opinicon the station. We look forward to continued support and cooperation with these many friends and neighbours in the Lake Opinicon area.

I would also like to thank Gerry Morris who is Department Head in Biology. He has been most supportive of this project. I would like to thank Denise Cameron who has helped with logistics and organizing this dedication. Finally, I would like to thank my wife Lois for her help in this project.

I would now like to introduce Dr. Dave Turpin. Dave Turpin is our Dean of the Faculty of Arts and Science at Queen's. We feel very fortunate to have a Dean who is a biologist, and especially one who has taught field courses. When I asked Dave last September, whether the university would support our efforts to acquire this Back Lakes area, Dave responded with a very enthusiastic "yes!". I certainly appreciate that help from the Dean's Office and the upper administration. I am very pleased that Dave is here with us today and that he is willing to address the gathering.

**Dr. Dave Turpin**  
Dean of Arts and Science  
Queen's University

Thanks Raleigh. It's truly a very great pleasure to have the opportunity to thank Mrs. Pangman on behalf of the Biological Station, the Department of Biology, the Faculty of Arts and Science, and Queen's University for the commitment and support shown by the donation of the Hilda and John B. Pangman Conservation Reserve. It truly is a remarkable gift and it will be something that will be remembered for generations to come.

The mandate of the Biological Station includes the provision of secure sites for use in research and teaching in field biology, conservation, and natural history. In so doing it contributes to better understanding and protection of our natural heritage. The cornerstone and success of the Biological Station has been the acquisition of land for teaching and research. Raleigh has already talked about the acquisitions and the addition of the Hilda and John B. Pangman Conservation Reserve with the associated 1500 acres increases by 50% the total land holdings of the Biological Station.

QUBS is really about teaching and learning. To give you an example, in 1993, students from over 11 universities in Ontario enrolled in courses taught here at the biological station. Each year approximately ten field courses are held and they are taught, not only by Queen's Professors but faculty from universities around Ontario and from other provinces and from the United States. Examples of the types of course taught include acoustic communication in birds, ecological interactions, behavioural ecology, limnology (the study of lakes), insect taxonomy and systematics, and the evolutionary ecology of plants. Thousands of students have had the opportunity to participate in these courses and in field trips from courses offered on an intramural basis at Queen's University. Having had the opportunity to teach those field courses, I can tell everyone of you that there is no experience like a field course to really understand the way in which the natural environment works. The students that have come through here have had the opportunity to experience that first hand. The acquisition of this additional reserve will increase the educational opportunities.

Research also plays a key role and researchers use this station. Researchers are not only from Queen's but from universities across Ontario, and in fact around the world. In 1993, the station boasted over 7500 user-days for teaching and research. So that gives you some indication of the level of use of this facility. This represents nearly a 60% increase in use over the preceding decade. There is every indication that it's going to continue, because in May, Senate approved the establishment of the School of Environmental Studies at Queen's which will link the Biology Department in an educational program with Geology, Chemistry, Geography, History, Sociology, and Economics. The position of the Biology Station, the opportunity for field courses for research and education, is going to continue to grow and it's going to be supported with the acquisition of this reserve.

QUBS is about providing secure tracts of natural study sites. By providing the gift of the Hilda and John B. Pangman Conservation Reserve, Mrs. Pangman has provided the gift not only for Queen's

but for future generations of Canadians. And I would like to ask Mrs. Pangman to come up here and help unveil a replica of the plaque that will be displayed on a prominent rock outcrop in the reserve.

[plaque unveiled]

I would like to read this to you. This inscription was written by Mrs. Pangman and it says:

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.

Mrs. Pangman, on behalf of everybody here, everybody at Queen's, and the future generations of Canadians that are going to take advantage of this preserve, thank you very much.



Pangman Dedication - Before the Ceremony

L to R: Dr. Rod Fraser, Ann Pangman, Peter Pangman, Mrs. Hilda Pangman, Dr. Allen Keast



### Donation of Bracken Tract

In the autumn of 1994, through the generosity of George and Margaret Bracken, a property encompassing some 500 acres was donated to Queen's University. George Bracken is a well-known land surveyor from Smiths Falls and a Queen's alumnus. The property, was donated to Queen's in memory of George's parents. The Bracken Tract is located near the village of Newboro and has extensive frontage on Newboro Lake.

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 is not currently 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.

Through the generosity of George and Margaret Bracken, the property was donated to Queen's University. On March 31, 1995, a ceremony recognizing the donation will take place at the University Club. At that time, a plaque in appreciation of the donation will be unveiled. This plaque will be installed and displayed on the property.

Thank you to the Brackens from QUBS! It is hoped that this property will foster interconnections between departments at Queen's, especially Geological Sciences and Biology.

### Pearl E. Williams and Llewellyn Hillis Fund

In 1994, with funding from the Pearl E. Williams and Llewellyn Hillis Fund, two presentations from local artist Turid Forsyth were made (one in conjunction with Friends of Opinicon). This fund is dedicated to increasing linkages between the field station, the arts and women. Turid's presentations were well-attended and informative. Rarely does one get a chance to gain insight into the motivation of an artist skilled in many media - her techniques, interests and intentions. The question and answer period following each talk was lively, expressing enthusiasm and interest in Turid's work. As an additional part of this program, Turid will create a painting that depicts some of the habitats, flora and fauna of QUBS. Eventually, this painting will hang in the new lodge at QUBS. Finally, Turid will conduct a 3-day workshop on Art in Nature during July, 1995. Clearly, availability of this Fund is enriching the lives of Station regulars, other members of the Queen's community, and Friends of Opinicon.

### Friends of Opinicon - (by Nasrene MacDonald)

1994 has been a successful year for the F of O. Our membership numbers have grown this summer as more people have shown interest in being included in activities such as the nature walks and the evening seminars at QUBS.

The Thursday evening nature walks were well attended, although we didn't walk very far, for the most part. However, everyone had the opportunity to do some nature study, to stop, to observe and to ask questions of our experienced, entertaining and patient guide, Floyd Connor. This year we also offered some longer hikes on Sundays and this turned out to be popular with the more energetic members. One hike saw us exploring the lakes on the Pangman Conservation Reserve. Another trip took us to the farm of Peter and Joan Gillespie near Narrows Lock. Here, some interesting caves were featured. Another occasion took us across Lake Opinicon by barge to the Cape-Sauriol Environmental Studies Area and a hike on the recently opened trails. [Naz's island potluck supper was again very well attended, with a lot of enthusiastic conversation and sharing among the "Friends" (WFC)].

Two seminars co-sponsored by the Friends at QUBS were very popular. By popular request, Dr. James Fullard gave a reprise of his spirited talk on bats. With the capture and light-marking and subsequent release of many male Big Brown Bats, this evening was a big hit with QUBS regulars and neighbours alike. Thanks, James! The second seminar, also well-attended, was a fascinating evening with local artist-photographer Turid Holldobler Forsyth, funded by the Williams - Hillis Fund. Turid took us into her special world of art and nature.

Next summer, F of O will continue evening walks, are planning longer hikes on weekends and more seminars on such topics as loons, rat snakes, bird identification, fish habitat etc.

### Seminars

Raleigh and Frank organized the seminar program for 1994. 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 10 in 1994. We hosted about 225 visitors during the day. Numbers were down a bit from previous years, but the threat of rain early in the day may have had a lot to do with that. Judging by comments received, the visitors greatly enjoyed 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 1994 version of the Community Newsletter (fourteenth edition) was distributed in early July to more than 700 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.

### 1994 Renovations and Additions

In 1994, a number of changes and improvements were made to QUBS facilities. These included: (1) Before the summer season, a roof-mount ventilation fan was installed to vent hot air from the conference room of the Brown Lab. This fan has improved the environment of the conference room for use by large groups in warm weather. Funds for this installation were provided by Dr. Gerry Morris (Chair, Biology Department). (2) In spring, we painted the dining room, living room and hallways in the White House. In addition, the ceilings in the upstairs bathrooms were painted. (3) We finished replacing the old bunks in the Bunkie Junior cabins. Replacement bunks were fashioned, fastened to



the walls and feature plywood foundations instead of the old, saggy wire springs. (4) In the lodge, a new side counter for the food service was built. This replaces the occasional tables around the corner from the serving window, adding extra space for presentation of food and storage of dishes etc. (5) Room 1 in Curran cottage was revamped. The old window was removed and replaced with an insulated casement window. The north-facing wall was insulated and covered with drywall. All walls were repaired and painted. New carpeting was laid on the floor. With this renovation, all of the bedrooms in Curran have been upgraded. (6) The leaky roof on Cabin 4 was repaired by reshingling in summer. (7) Old cabin 6 (still suffering from the storm damage wrought by the tornado of '78) was removed from its footings, and a new, larger cabin was built on the old site. This new cabin, twice as large as the old model, provides extra space for a desk and enables extended season use (insulated). Old #6, once off its footings, was properly repaired and instead of dismantling it, it was moved and reinstalled at a new site in the top line of cabins between cabins #4 and #5. As a result of the changes in recent years and the addition of new cabins, it has been necessary to renumber all of the cabins. The new scheme begins with Cabin #1, next to the lodge and progresses counterclockwise around the loop in the road. Hopefully, the logical numbering system will assist new users of the station in locating particular cabins. For long-term regulars, disabusing ourselves of the old notion will take some time. (8) A new compressor for the main refrigerator in the lodge was installed upon failure of the old one. (9) The library was rewired to isolate the electrical circuit serving the photocopier. This change should preclude the continual breaker flipping needed to keep services to the library. (10) In the lower Brown lab, two overhead plugs were installed above the large desks. These twist-lock outlets should prevent the snarl of wires across traffic space in the lab. Power bars supplied by these outlets now rest in the middle of each table. (11) In the White House, we removed the ceiling in the main room of the Apartment. We reinforced the floor of the upper level living room (which forms the ceiling of the Apartment) by twinning all of the floor joists. The ceiling was then restrapped and a new ceiling installed. At the same time, new, improved lighting was installed in the ceiling to better illuminate the Apartment. This repair both strengthens the floor of the busy, heavily used upper living room and repairs the falling ceiling in the lower main room. (12) New carpeting was installed in the bedrooms of the White House Apartment, replacing the well-worn originals. (13) In summer, aluminium soffit was installed on the gable ends of the White House. This both improves the appearance of the gable soffits and enables better air circulation to the attic. At the same time, aluminium fascia was used to cover the wooden fascia. All exterior window frames were also painted during this work. (14) To keep rain, snow and ice from falling on people's heads when entering the White House and Brown Lab, false porticoes were added to the roofs of these buildings. By diverting the runoff down the valleys of the porticoes, the entries remain free of drips etc. (15) Paper towels clogged the intake of the sewage pump in front of the White House. Eventually, the bearings wore out and the pump had to be replaced. A delightful job, but necessary. Hopefully, QUBS users can be prevailed upon to keep inappropriate material out of the septic systems in future. (16) The south roof of Curran Cottage is quite flat and has presented problems with water infiltration in the past. Past repairs using salve-edge roofing, sealants etc. have been temporary, at best. This summer, we added a more steeply pitched roof, by building new rafters overtop of the old roof. The new roof is approximately a 4/12 pitch, which should solve the leaking problem of the old roof. (17) In conjunction with the roof repair on Curran Cottage, we removed and replaced the water-damaged ceiling in bedroom #5. (18) To keep up the fences flanking the entrance road into the station, all fenceposts in poor condition were replaced and the fences repaired and tightened. Similarly, all gates were checked and received necessary maintenance. (19) Curran Cottage was scraped, primed and painted in late summer. (20) The sagging entrance deck on the east side of Curran Cottage was removed and replaced in late summer. (21) Similarly, the entry steps to Keast Cottage were removed and replaced with a small entry deck. (22) To improve attic ventilation, roof vents were added to the roof of the Manager's House, White House, Brown Lab and Library. Hopefully, this will reduce condensation in interior corners during winter and will reduce attic temperatures in summer, resulting in cooler conditions inside these buildings. (23) In fall, the cedar-sided buildings (Cabins #6, #13 and #14, Maplewood and Sumac Cottages) were sprayed with a cedartone sunblock stain. At the same time, the decks on Sumac and Maplewood were sprayed. (24) Topsoil was spread and grass was established on the septic system at Maplewood Cottage. This completes the construction of this cottage. (25) In summer, a four-wheel drive work

truck was purchased. The cost of the truck was split between the Biology Department (via Dr. Gerry Morris) and QUBS. This 1990 Ford half-ton is a huge improvement over the old truck. The old grey Ford was sold in fall. (26) As a result of the availability of a four-wheel drive truck, a snowplow was purchased and installed in early winter. Now, we have the capability of easily keeping the station road clear throughout the winter. With the snowblower on the tractor to handle large snowfalls, built-up snowbanks and parking lots, snow removal is no longer a problem. Funds for the purchase of the snowplow came from the QUBS Trust. (27) In fall and early winter, the upstairs bathroom in the Manager's House was completely renovated. Starting out as a facelift, but soon discovering carpenter ant and water damage in the walls and floors, the project soon became a wholesale renovation. The old tub, vanity, walls, flooring, floor, toilet and exhaust fan were removed. Then, a new floor, vinyl flooring, toilet, tub, water-resistant drywall, ceramic tiles in the tub, shower doors, high-volume exhaust fan and sink and vanity were installed. (28) Two Macintosh computers and a laser printer were acquired from the Biology Department (via Dr. Bob Montgomerie) in fall. These will necessitate a revamping of our computer workspace at QUBS. The total number of computers now at QUBS has grown to seven.

### The Weather Report

Weather data services were improved and expanded in 1994.

Throughout the meal service season, a daily graphical and tabular summary of the preceding 28 hours of data for eight of the monitored weather variables was delivered to residents at the breakfast table. This was frequently accompanied by a brief forecast for the next 1 to 3 days. Wind direction data processing was changed to more accurately deal with variability around the 360-degree compass position (True North). At the requests of individual users, existing 20-minute and 24-hour weather data summary files were, for varying periods of time, supplemented by 5-minute summaries and 10-minute summaries for selected variables. All of these files are permanently stored for future use.

A few repairs and restorations were also done to the weather monitoring system in 1994. Shortly after a violent windstorm in late May (which also sank boats at our dock!), the anemometer was briefly taken out of service for the replacement of a burned-out bearing. The same storm snapped the sensor tip from the water surface temperature probe, but this was soon repaired by Frank and Floyd. Finally, Raleigh's old CR21 micrologger, which had formed the heart of the Station's weather monitoring system until replaced by the current 21X in 1991, was resurrected as a mobile field monitoring station. Greg Brown was able to use it successfully in some of his snake studies, and indications are that there will be at least one user of this "ancient" hardware in 1995.

Readers are referred to the included graphical summaries of selected weather variables for the QUBS main monitoring site, for the ice-free season on Lake Opinicon in 1994. The intent is to give past and potential users a glimpse of seasonal trends and averages as well as a look at individual weather events that might affect biological phenomena.

### Hummertime

The Hummertime project produced its eighth semi-annual newsletter and data summary at QUBS in November of 1994.

Designed to elucidate Ruby-throated Hummingbird migration and reproduction patterns through data provided by a network of home observers, the study is run by Kit Muma (a long-term researcher at QUBS), Peggy Latimer (a cottager neighbour of QUBS and "Friend of Opinicon"), and Floyd Connor. Dr. Bruce P. Smith has provided much greatly-appreciated assistance with data analysis and

presentation. The November newsletter was based on data from over 100 observers, representing nearly 400 total study participants.

We are delighted to report that we received another grant from the James L. Baillie Memorial Fund of the Long Point Bird Observatory to help us cover primarily printing and mailing costs of the Hummertime network into 1995. This is very important to us, for exciting new contacts promise to provide us with a substantially increased mailing list in 1995.

We are very thankful for the use of facilities and accommodations at the Biological Station for our summarizing and printing and planning meetings, and in particular for the use of the computers and LaserJet III printer donated by Hewlett-Packard.

#### Congratulations

On March 28, 1994, Miriam Tabak Gibbs was born. Congratulations to parents Dr. H. Lisle Gibbs (McMaster University) and Lisa Tabak.

On August 22, 1994, Michael Robert Layzell was born. Congratulations to parents Dr. Dave Layzell and Dr. Kathy Wynne-Edwards.

On August 23, 1994, Madison Claussen-Philipp was weighed in. This fine catch, 7 lbs. 5 oz. and 20.5 inches long, is a keeper. Congratulations to parents Dr. Dave Philipp (Illinois Natural History Survey) and Julie Claussen.

On November 16, 1994, Samantha Rose Weatherhead was born. Congratulations to parents Dr. Pat Weatherhead (Carleton University) and Karen Metz.

On January 15, 1995, Elizabeth Tufts was born. Congratulations to parents Dr. Bruce and Kim Tufts.

On August 28, 1995, Joe Justus and Hollie Devlin were married at Trent University. Best wishes!

On November 26, 1994, Dr. Heather Proctor was married to Dr. David Walter (University of Queensland). Congratulations! A mite of shared interest in mites mite have been involved here.

On December 16, 1994, Karen Wetmore was married to Steve Reynolds in Oshawa. Congratulations!

#### Station User Fees

In recognition of the fiscal climate, QUBS fees for 1995 will be unchanged from 1994. Hopefully, this will keep use of the field station possible for a wide range of researchers. The fee schedule for 1995 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

In 1994, Parks Canada - Rideau Canal, via Superintendent, Mr. John Bonser, provided QUBS with complimentary lockage passes for both of our pontoon boats (floating classrooms). This generosity, especially in view of fiscal restraints, is greatly appreciated and facilitates study of a variety of water bodies along the Rideau Canal during research and teaching initiatives. Many thanks to Parks Canada for their continued assistance.

#### 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), Rod Green (Maintenance Assistant), Marg Phelan (Food Service Coordinator), Karen Wetmore (Food Service Staff), Karen Curtis (Food Service Staff), Chris Deline (Food Service Staff) and to Ron Vinkle Jr. and Dave Bell (Part-time Assistants).

Cover: The cover of this report sports a design by Francine Lewis. Thanks, Frankie!



Table 1: Summary of course credits in the Ontario Universities Program in Field Biology earned at Queen's University Biological Station in 1994

Module Topic	Professor and Affiliation	Dates	Credit/ Student	Q	C	Y	B	Wn	Wo	To	Tr	G	O	M	Wl	Total Successful Students	Total 1/2 Course Credits
Bird Behavioural Ecology & Reproductive Strategies	Briskie (Q)	May 1 - 14	1/2	6			1				1	2	1	1		12	12
Vertebrate Reproductive Physiology	Wynne-Edwards (Q)	May 8 - 14	1/4	5		1	1			2	1			2		12	6
Ecological Physiology of Vertebrates	Tufts (Q)	May 15 - 21	1/4	3		1			2	1			1	2		10	5
Community Ecology of Birds	Lougheed (Q)	May 15 - 21	1/4	4		2	1		1		2		1			11	5.5
Biology of Bats	Fenton (Y)	Aug. 2 - 12	1/2	1	1	3	2				2		2			11	11
Evolutionary Ecology of Plants	Barrett (To)	Aug. 14 - 20	1/4	3		1			1	2						7	3.5
Insect Taxonomy and Ecology	Gunderman (M)	Aug. 14 - 20	1/4	1		2			2	2	2		1	3		13	6.5
Systematics of Flowering Plants	Pringle (M)	Aug. 21 - 27	1/4	5		3				2	1			1		12	6
Aquatic Community Ecology	McQueen (Y)	Aug. 21 - 27	1/4	4		3				2			1	2		12	6
Applied Ecology	Crowder (Q)	Aug. 28 - Sept. 3	1/4	8		3				1	2					14	7
Plant Variation, Diversity & Evolution	Aarssen (Q)	Aug. 28 - Sept. 3	1/4	6		1			1	1	1	1				11	5.5
Insect Mating Systems	Conrad (Q)	Sept. 4 - 10	1/4	5		2				2			1	2		12	6
Total Number of Student - Weeks				58	2	25	8	8	7	15	15	5	11	14	0	160	-
Half- Course Equivalents				29	1	12.5	4	0	3.5	7.5	7.5	2.5	5.5	7	0	-	80

Table 2: Summary of course credits in the Ontario Universities Program in Field Biology earned at locations other than QUBS in 1994

Module Topic	Professor and Affiliation	Dates	Location	Credit/Student	Q	C	Y	B	Wn	Wo	To	Tr	G	O	M	Wl	Total Successful Students	Total 1/2 Course Credits
Tropical Ornithology	Stutchbury (Y)	Feb. 12 - 28	Peru	1/2	2		1					1					11	11
Tropical Marine Ecology	Barton & Dutton (Wl)	Apr. 21 - May 8	Jamaica	1/2	2		1			1	10			1	1		16	16
Field Ornithology	Rising & Parsons (Yl)	May 3 - 17	Sequoia Natl. St.	1/2	2	1			2			18				1	24	24
Seabird Breeding Biology	Quinn (M)	May 15 - 26	McKean Is.	1/2	1		1		3			1					13	13
Great Lakes Field Biology	MacIsaac/MacIsaac (Wl)	May 15 - 26	Univ. of Windsor	1/2	1				1		1	3			2	8	18	18
Marine Developmental Biology	Bates (C)	May 29 - June 11	Hunterman Marine Lab	1/2	2	4	1							1			9	9
Urban Insect Diversity	Peckler (Y)	June 12 - 18	York Univ.	1/4	2		7					1			1		12	6
Neotropical/Andean Reproduction	Purman (C)	June 15 - 30	Orizaba	1/2	1		2		2					2			6	6
Design & Stress for Ecol. Studies	Green (Wl)	June 20 - 30	Kananaskis, Alta.	1/2	4				2		1					1	7	7
Alpine Plant Ecology	Coxson (M)	July 17 - 30	Kananaskis, Alta.	1/2	1		2				1				1	1	6	6
Biology of Marine Mammals	Kovacs (Wl)	July 31 - Aug. 13	Hunterman Marine Lab	1/2	8				2		1						14	14
Fish Resources - East Mgmt.	Urbak (Wl/O)	July 31 - Aug. 13	Hunterman Marine Lab	1/2	1					1	1	1					4	4
Biodiversity of Argentina	Hendrick et al. (Wl)	Aug. 1 - 20	Argentina	1/2	1	1	1	1	3	1	1			1			10	10
Wetland Ecology	Knapp (Wl)	Aug. 28 - Sept. 2	Long Point	1/2	3		1			4	1				2		11	11
Field Ecology	Banks et al. (Yl)	Aug. 14 - 27	WRMS Algonquin Park	1/2			1		2	1	2		10		1		17	17
Marine Biology & Oceanography	Bellars (C)	Aug. 15 - 29	Hunterman Marine Lab	1/2	2				1				13	1	1		22	22
Avian Ecology	Helen, Kavan & Hull (C)	Aug. 17 - 31	Iqaluit	1/2					1	1			11				15	15
Marine Biology	McGowan et al. (Yl)	Aug. 20 - Sept. 3	Hunterman Marine Lab	1/2	1		1	2		1	15						20	20
Molecular Ecology of Birds	Obbs (M)	Aug. 21 - 27	McMaster Univ.	1/4	1		1	2	1		2						9	4.5
Aquatic Ecology	Baker & Trick (Wl)	Aug. 21 - Sept. 3	WRMS Algonquin Park	1/2		1			6		2	1					11	11
Exp. Studies in Marine Biology	Owen et al. (Wl)	Aug. 26 - Sept. 11	Hunterman Marine Lab	1/2	6		2		9	4			1				22	22
Comparative Ornithology of Ontario	Zimmerman et al. (Yl)	Aug. 27 - Sept. 2	Sochten Ontario	1/4	2		1		1	1	3			2			10	5
Terrestrial & Aquatic Biology	Hawthorn et al. (Wl)	Aug. 27 - Sept. 8	WRMS Algonquin Park	1/2	2		2	1	1	8	1	1					18	18
Mycology	Kendrick (Wl)	Sept. 3 - 17	WRMS Algonquin Park	1/2	1					11							12	12

Table 3: Overall Summary of the Ontario Universities Program in Field Biology for 1994.

	Q	C	Y	B	Wn	Wo	To	Tr	G	O	M	Wi	Total Student-Weeks in Modules	Total Half-Course Credits
Total Student-Weeks Not at QUBS	91	16	47	10	76	88	107	21	76	12	37	20	601	300.5
Total Student-Weeks at QUBS	58	2	25	8	0	7	15	15	5	11	14	0	160	80
Total Student-Weeks in Field Modules	149	18	72	18	76	95	122	36	81	23	51	20	761	-
Total Half-Course Equivalents in Field Modules	74.5	9	36	9	38	47.5	61	18	40.5	11.5	25.5	10	-	380.5

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

21% of credits in entire program earned at QUBS in 1994  
(13.8% in 1993; 19% in 1992; 14.1% in 1991; 16.3% in 1990; 29.2% in 1989)

38.9% of Queen's credits earned at QUBS in 1994  
(28.4% in 1993; 33.6% in 1992; 15.8% in 1991; 24% in 1990; 51.4% in 1989)

## 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 1994. Sarah Totton, with the assistance of Dr. Rowland Tinline (Queen's - Geography), helped complete the mapping of survey lines of all QUBS tracts. In addition, mapping of features (roads, paths, buildings) was started. At present, the base map is nearing completion. 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 1994, the Hughson Tract was heavily used in studies of water snakes, black rat snakes, tree swallows, red-winged blackbirds, water mites, dragonflies and damselflies, secondary succession, and ragweed.

Haying of the open fields by Bob Butterill and David Hughson continued in 1994. In fall, the edges of most of the fields were trimmed using a bushhog to control encroaching woody growth.

In fall, Dr. Lonnie Aarssen established some long-term plots in the Lane Sargent field. These large plots will provide a range of conditions for various stages of succession. Some plots have been freshly plowed, others will be mowed, while yet others will not be mowed.

### Bonwill Tract

In 1994, the Bonwill Tract was used in studies of songbirds, especially Cerulean Warblers and Redstarts, black rat snakes, plant ecology, growth and yield and forest management.

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

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.

Ontario Ministry of Natural Resources (Eric Boysen - Kemptville) established several growth and yield plots flanking the Bedford Road. This long-term project samples a range of forest types, documenting tree growth patterns in Ontario.

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

In 1994, the Cape-Sauriol E.S.A. was used in catch-and-release studies of bass, and studies of water mites.



The walking trail from the Wright homestead to the site of the old bridge across the Hart Lake Channel received trail maintenance in 1994.

With the Pangman donation, as part of the purchase from the Rock Lake Association, QUBS obtained Lot 21, which consolidates the Cape-Sauriol E.S.A.. This lot contains the southern section of the Mill Pond and Pothole Lake.

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

In 1994, the Pangman Reserve was used in studies of bass (in the 6 lakes), songbirds, and forest management.

In early winter, the survey of the western boundary, needed for defining the property for registration purposes, was completed.

#### Bracken Tract

In 1994, initial exploration of the Bracken Tract was undertaken.

One of Dr. Vicki Remenda's (Queen's - Geological Sciences) students, as part of a thesis, is preparing a land-use history of this property.

### *Naturalists' Workshop 1994*

In 1994, QUBS offered its sixteenth edition of the naturalists' workshop. The week-long workshop was held from May 21 through May 28, with an enrolment of 15. These participants represented a cross-section of people with interest in natural history and environmental topics (one teacher, one student, five amateur naturalists, one environmental consultant, four staff from the Ontario Ministry of Natural Resources and three staff from Conservation Authorities). In 1994, special themes focussed on forest bird communities, small-scale mining and old growth forests.

The McCorquodale Scholarship was awarded to Carmen Penty, a homemaker, part-time student (University of Northern Illinois) and part-time nature interpreter. This scholarship adds an extra dimension to the naturalists' workshop programme, enabling attendance of someone who might not otherwise be able to attend because of financial constraints. A very big *thank you* to Shannon McCorquodale, a workshop alumnus and long-time friend of the field station, whose continuing generosity provides the scholarship named after her.

This year's team of instructors was headed by Dr. Jim Pringle (Royal Botanical Gardens). Because of time and travel commitments, Dr. Adele Crowder's involvement with the workshop this year was limited. Thanks to you both for your continued involvement with the programme. The workshop continues to be successful, in large measure, because of the devotion of time and effort of all workshop instructors: Floyd Connor (QUBS), Dr. Francis Cook (National Museum of Nature and McGill University), Don Cuddy (Ontario Ministry of Natural Resources), Jennifer Harker (M.M. Dillon Consultants), Jim Ives (OMNR - Murphy's Point Provincial Park), Dr. Allen Keast (Queen's - Biology), Dr. Sandra McBride (Queen's - Geological Sciences), Dr. Gray Merriam (Carleton University - Biology), Cathy Nielsen (Ontario Ministry of Natural Resources), Frank Phelan (QUBS), Dr. Bruce Smith (Ithaca College - Biology), Merebeth Switzer (OMNR - Murphy's Point Provincial Park), Shawn Thompson (Ontario Ministry of Natural Resources) and Gus Yaki (Nature Travel Service).

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.

This year's workshop featured two excellent road trips, one short, one long. The first (short) trip took us to Murphy's Point Provincial Park. Here, park staff treated us to a tour of the Lally Homestead, Silver Queen Mine (with a special visit from Mica Mike Murphy) and the Beaver Pond Trail. The second trip (long) took us to Shaw Woods Nature Preserve, north of Eganville. This plot of old-growth forest was impressive, with a rare mix of old trees, soaring to 30+ metres in height. It is awe-inspiring to experience such a forest, while at the same time sobering, to think that much of the forest in eastern Ontario had been like this.

For 1995, we are planning a reformatting of the Naturalists' Workshop programme. Partly as a result of space and time limitations imposed by other uses at QUBS and a desire for a more intensive look at narrower topics, the week-long workshop will not be offered. Instead, several three-day workshops on selected topics will be offered. Topics under consideration include: Harbingers of Spring (early-season amphibians and birds), Bog Ecology and Development, and Wetlands and Geology. Final plans for the 1995 edition of the workshop should be available shortly.

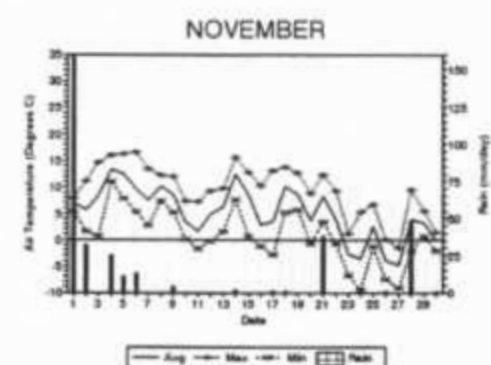
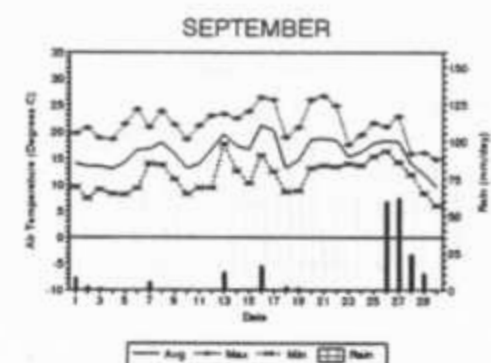
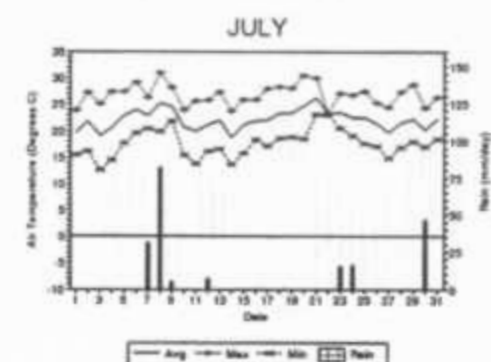
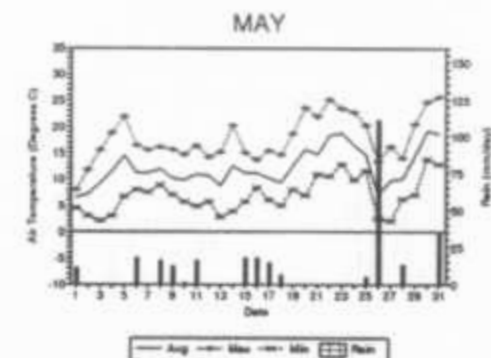
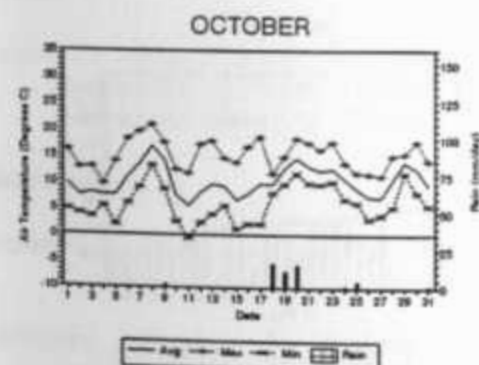
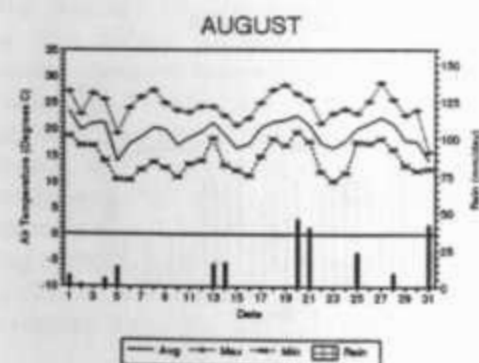
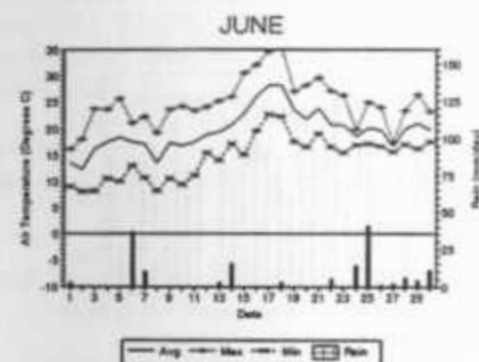
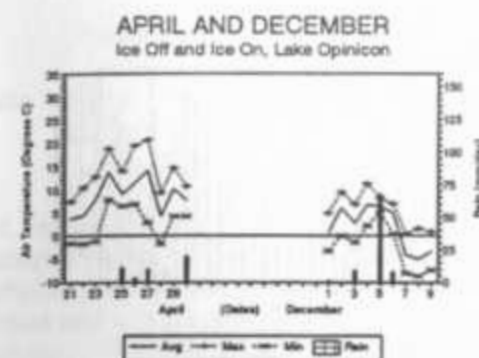
# 1994 Naturalists' Workshop Participants

Pamela Burns  
 Ted Rosen  
 Dan Blais  
 Laurie Richardson  
 Steve Pitt  
 Mary Guest  
 Kathryn Dinsmore  
 Linda Baker  
 Mary Campbell  
 Sandra McGuire  
 Carmen Penty  
 John McKenzie  
 Janet Wong  
 Aldo Missio  
 Ingolf Lambrecht

Rondeau Provincial Park, RR#1, Morpeth, Ontario  
 Amateur Naturalist, Toronto, Ontario  
 Sandbanks Provincial Park, RR#1, Picton, Ontario  
 Teacher, Belleville, Ontario  
 Resource Technician, OMNR, Napanee, Ontario  
 Amateur Naturalist/Part-time student, Peterborough, Ont.  
 Amateur Naturalist, Toronto, Ontario  
 Amateur Naturalist/photographer, Kingston, Ontario  
 Amateur Naturalist, Toronto, Ontario  
 Consultant, Kingston, Ontario  
 Cooper Marsh, South Lancaster, Ontario  
 Senior Fish/Wildlife Technician, OMNR, Brockville, Ont.  
 Cataraqui Region Conservation Authority, Kingston, Ont.  
 Claremont Field Centre, Claremont, Ontario  
 Student, Royal Ontario Museum, Toronto, Ontario

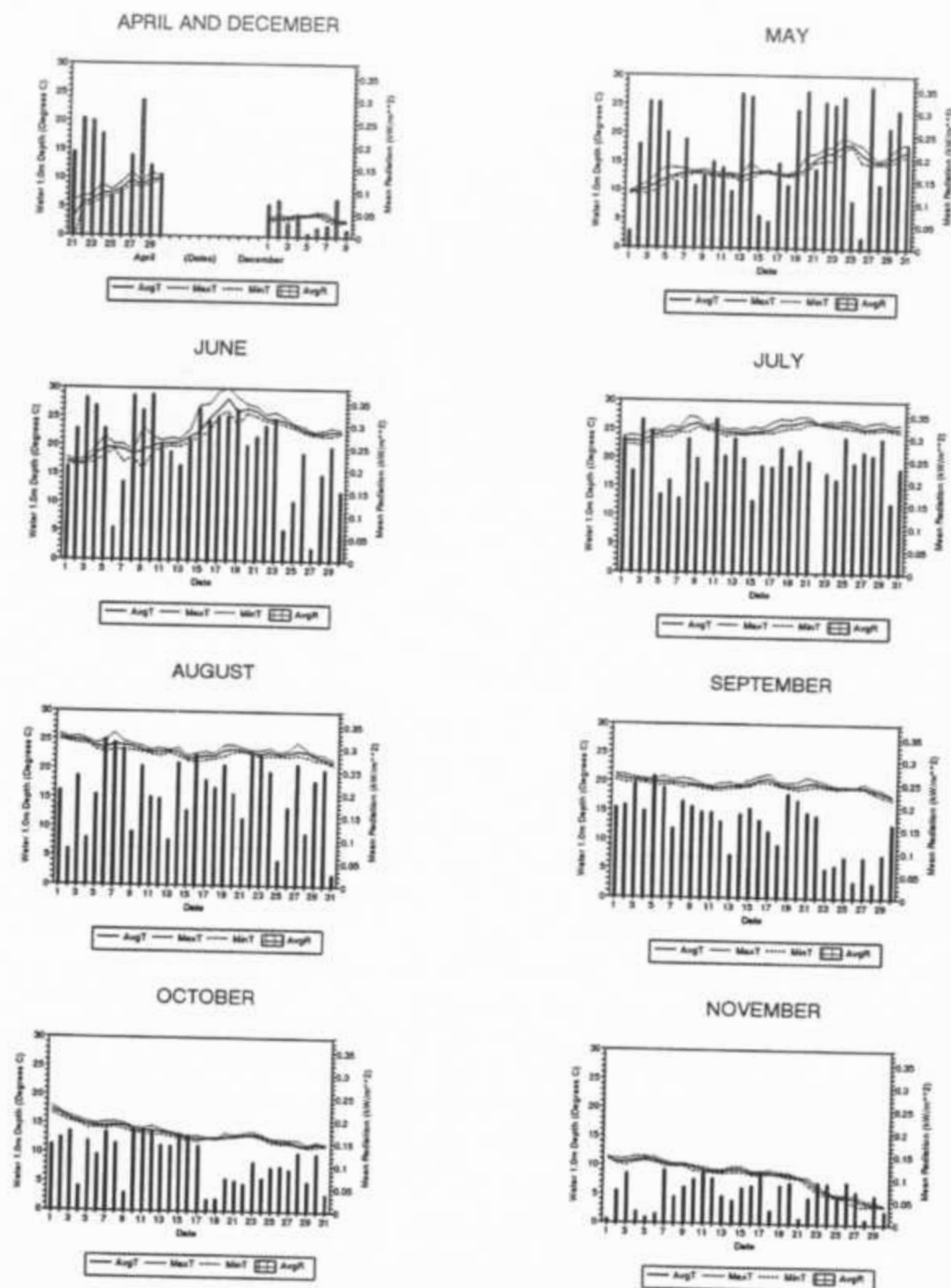
## AIR TEMPERATURE AND RAIN SUMMARIES FOR QUBS 1994

Ice-free season on Lake Opinicon - 21 April to 9 December





WATER (1.0M DEPTH) TEMPERATURES AND MEAN DAILY RADIATION FOR QUBS 1994  
Ice-free season on Lake Opinicon - 21 April to 9 December



# I: Research by Queen's Students and Staff

Dr. Lonnie Aarssen

## "Plant Ecology and Evolution"

Judie Venecz - "Response of Purple Loosestrife, *Lythrum salicaria* to shoot apex removal" - M.Sc. Thesis

This study is examining how the removal of shoot apices and inflorescences affects growth and reproduction in purple loosestrife. Ducks Unlimited has suggested to its audiences (primarily cottagers) that removal of inflorescences might be an effective control measure, by limiting reproductive output. We predict, however, that inflorescence and shoot apex removal may serve to release lateral buds from apical dominance which may actually result in greater ("overcompensatory") reproduction and/or growth. The field study was carried out in Stumpy Bay at QUBS. Four treatments were applied: one group of plants was clipped three times at the beginning of the season (pre-flowering); another group was clipped three times pre-flowering and three times post-flowering; another group had only inflorescences removed whenever they appeared; the final (control) group was left undisturbed.

1994 was the second field season for this study. Data analyses (currently under way) will test the effects of the various shoot removal treatments on growth and reproduction in each of two years: 1993 (the year of treatment) and 1994.

Hazel Symonds - "Effects of plant architecture on gender allocation and fitness components in Common Ragweed, *Ambrosia artemisiifolia*" - B.Sc. Thesis

This study is using common ragweed to examine the potential for adaptive phenotypic plasticity in the relationship between size and fecundity (fecundity allocation) and in the relationship between size and pollen production (pollen allocation), mediated through architectural responses to environmental variation. Plants were exposed to a variety of treatments that affect plant architecture by affecting the strength of apical dominance: shoot apex removal (simulated herbivory), neighbour mediated alteration of red:far red light balance, non-injurious mechanical stimulation (simulated wind) affecting thigmomorphogenesis. The monoecious floral habit and short life cycle of this species also permits a test of whether plants that have a shoot apex removed can "overcompensate" in terms of both male and female lifetime fitness components. Fecundity allocation in experimental plants is also being compared with fecundity allocation in relatively rare all-female ragweed plants from several local populations. This will permit an estimate of the cost of producing pollen in monoecious plants in terms of reduced fecundity (relative to all-female plants).

## Theses:

Venecz, J.I. 1994. Effect of shoot apex removal on growth and reproduction in a perennial herb, purple loosestrife (*Lythrum salicaria*, Lythraceae). M.Sc. thesis, Department of Biology, Queen's University, Kingston, Ontario.

## Publications:

Bonser, S. and L.W. Aarssen. 1994. Plastic allometry in young sugar maple: adaptive responses to light availability. *Am. J. Bot.* 81:400-406.

Lundholm, J.T. and L.W. Aarssen. 1994. Neighbour effects on gender variation in *Ambrosia artemisiifolia* L. *Can. J. Bot.* 72:794-800.

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

Murphy, S.D. and 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. Sci.* (in press).

Murphy, S.D. and L.W. Aarssen. 1995. *In vitro* allelopathic effects of pollen from three *Hieracium* species (Asteraceae) and pollen transfer to sympatric Fabaceae. *Am. J. Bot.* (in press).

Dr. Christopher G. Eckert

"Plant Evolution & Population Genetics"

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

The shift from outbreeding to inbreeding is a major evolutionary trend in flowering plants. The extensive theoretical work examining this transition predicts two evolutionarily stable endpoints of mating-system evolution: predominant self-fertilization or complete outcrossing. My ongoing work with the tristylous, aquatic plant *Decodon verticillatus* (Lythraceae) presents an empirical challenge to this theory. Contrary to theoretical predictions *Decodon* practices intermediate levels of self-fertilization (about 30%). Moreover, selfed seeds rarely survive to sexual maturity due to very strong inbreeding depression. Why does this species waste a third of its reproductive effort on apparently inviable progeny? Understanding the adaptive significance of selfing (or lack thereof) requires determining how and when self-fertilization occurs. This summer, I initiated a field study in which opportunities for self-fertilization were experimentally controlled by manipulating the gender of individual flowers and/or whole plants. Marker gene analysis using protein electrophoresis can then be used to reconstruct mating patterns and determine the mechanisms and ultimately the evolutionary costs and benefits of self-fertilization.

Chris Eckert, Domenica Manicacci (CNRS, France) & Spencer Barrett (University of Toronto) - "The population genetics of rapid colonization by purple loosestrife (*Lythrum salicaria*, Lythraceae)"

We have been investigating the colonization genetics of purple loosestrife (*Lythrum salicaria*, Lythraceae) for the last six years. This native of Eurasia has recently invaded wetland habitats across eastern North America (especially those around QUBS), and there is much concern about the effect of this invasion on native wetland plants and animals. Our ongoing studies are examining the influence of founder effect, genetic drift and explosive population growth on genetic diversity in colonizing populations. This summer, we completed a large-scale comparison of genetic variability in native populations in southern France and introduced populations in the QUBS area. We also finished a five-year study on the effect of explosive population growth on the dynamics of the sexual system in colonizing populations around QUBS.

Greg Grabas - "Floral variation in *Decodon verticillatus* (Lythraceae): The effect of polymorphic and continuous variation in style length on female reproductive success" - B.Sc. Thesis

Floral morphology is believed to be under strong selection for efficient pollen import and export mediated by animal pollinators. Of particular importance is the spatial positioning of male and female organs within the flower. Testing this hypothesis requires an examination of the costs and benefits of alternative floral morphologies in terms of both male and female function. This summer, I exploited the

wide range of floral variation observed in a local population of the tristylous aquatic plant *Decodon verticillatus* to examine the effect of variation in style length on female reproductive success. Several components of female success (stigmatic pollen loads, pollen tube growth in the style and seed production) were compared among the three tristylous floral morphs differing in style length, as well as in a large sample of one morph exhibiting extensive continuous variation in style length. Preliminary results suggest that longer is not always better.

Publications:

Eckert, C. G., & S. C. H. Barrett. 1995. Style morph ratios in tristylous *Decodon verticillatus* (Lythraceae): selection vs historical contingency. *Ecology*, in press.

Eckert, C.G., & S.C.H. Barrett. 1994. Inbreeding depression in partially self-fertilizing *Decodon verticillatus* (Lythraceae): Population-genetic and experimental analyses. *Evolution* 48: 952-964.

Eckert, C.G. & S.C.H. Barrett. 1994. Post-pollination mechanisms and the maintenance of outcrossing in self-compatible *Decodon verticillatus* (Lythraceae). *Heredity* 72: 396-411.

Eckert, C.G. & S.C.H. Barrett. 1994. Floral variation, self-compatibility and tristily in *Decodon verticillatus* (L.) Ell. (Lythraceae). *Biological Journal of the Linnean Society* 53: 1-30.

Eckert, C.G. & S.C.H. Barrett. 1993. The inheritance of tristily in *Decodon verticillatus*. *Heredity*, 71: 473-480.

Eckert, C.G., & S.C.H. Barrett. 1993. Clonal reproduction and patterns of genotypic diversity in *Decodon verticillatus* (Lythraceae). *American Journal of Botany*, 80:1175-1182

Barrett, S.C.H., C.G. Eckert & B.C. Husband. 1993. Evolutionary processes in aquatic plant populations. *Aquatic Botany*, 44: 105-145.

Eckert, C.G., & S.C.H. Barrett. 1992. Stochastic loss of style morphs from populations of tristylous *Lythrum salicaria* and *Decodon verticillatus*. *Evolution*, 46: 1014-1029.

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. This project is aimed at correlating this patchiness with climatic, soil and neighbouring vegetation factors, but will also study the positive feedbacks that may enhance patchiness starting with random processes in homogeneous fields.

This season all woody plants were mapped and described in detail (species, height, stem diameter, crown diameter, condition) in all 27 (100m<sup>2</sup> each) plots that have been monitored since 1975. Spatial analysis at various scales will indicate degrees and scales of patchiness, and the results will be used to plan various experiments for the 1995 season aimed at elucidating the causes of the patchiness.

Larysa Snihura - "Selective herbivory by *Microtus pennsylvanicus* on young trees" - B.Sc. Thesis.

The heavy snow conditions of the 1993-94 winter allowed for localized dense populations of voles. Some of these outbreaks occurred within our research area and had a major effect on some of



the plots. The mortality and damage inflicted on young trees was recorded. Sugar maple is the most heavily affected species, elm the least. Damage is highest in areas where grass and trees are both present. This work suggests that sugar maple is a late successional species not because of late invasion or drought sensitivity, but primarily because of high sensitivity to herbivory.

Natasha Seigel - "Seed germination in five species of dogwood (*Cornus*)" - B.Sc. Thesis.

Five species of *Cornus* (*C. racemosa*, *C. obliqua*, *C. alternifolia*, *C. stolonifera* and *C. rugosa*) are found in the research area. All five species are early invaders, and are of importance both as ground cover and as a food source for frugivorous birds. Seeds of the five species were exposed to cold stratification and passage through captive wild turkey gut, and tested for viability and germinability. Wild turkeys feed naturally on dogwood berries.

Results indicate that seed dormancy is very strong in some species, and that turkey feeding reduces viability of the seed of all species.

Drs. Dolf Harmsen and Rowland Tinline (Department of Geography, Queen's University)

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

In conjunction with an international (US and Canada) project on raccoon rabies, this project is aimed at establishing season-, age- and sex-dependent raccoon contact rates, home range size and dispersal patterns.

The project will be carried out in 1995, but some preliminary trials were run in 1994 to test trapping, tracking and mapping methods. No research data were collected.

Drs. Dolf Harmsen and Adele Crowder

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

In 1994 this long-term project which was initiated in 1975 was given a shot in the arm through a two year grant from the Ontario Ministry of Agriculture and Food. The fields that this project focusses on are now into the transition stage from grass and forb dominance to shrub and tree dominance.

The objective of this phase of the project is to identify the processes whereby the early woodland species composition is determined. Our focus in 1994 was on seed dispersal, both by wind and by frugivorous birds, and on the effects of rodent herbivory on seedlings and saplings. Vegetation monitoring and mapping in both fields was resumed after a two-year break.

Assistants: Steven Lofters, Mark Grabas, Soni Singh

Dr. J. Allen Keast

#### "Studies on Bird Populations and Communities"

Long-term studies on monitoring of breeding bird populations and egg-laying dates was continued in 1994. Red-eyed and Warbling Vireo populations have had a long history of relative numerical stability both on Queen's Point (4-6 pairs of each species) and along the Lindsay Lake Road. These levels were maintained in 1994. These findings are interesting since the Red-eyed Vireo has shown a marked decline in numbers in the U.S. as a result of forest loss and fragmentation.

In the vicinity of Queen's Point, Least Flycatchers were virtually absent in 1994, after reaching a breeding density of ten pairs in 1992. House Wren numbers were down in 1994, although numbers

fluctuate appreciably in this species. Brown Thrasher numbers have never recovered from their sudden decline about 1976 and Whippoorwills now breed only in the most remote parts of the Queen's properties.

The Lake Opinicon data were combined with published material from Long Point Bird Observatory and various American studies for the writer's invited presentation, "The Nearctic-Neotropical Bird Migration System" at the International Migration conference at Elait, Israel in April of 1994. This manuscript is currently in press in the Israel Journal of Zoology.

Work continued on the ecomorphology of forest birds, with the gathering of quantitative data on vertical substrate use patterns and locomotory feeding movements and behaviour. These data are to be compared with morphological measurements from museum specimens. Ontario results were brought together at the international symposium "Forest Bird Communities - Inter-continental Comparisons" convened by the writer for the International Ornithological Congress in Vienna in August of 1994. It is being increasingly shown that there are good correlations between ecological role, way of life and subtle morphological features (e.g. wing shape; lengths of toes and claws; body weight). This, along with data on diet (relative to a fluctuating seasonal insect resource base) are providing insights into factors governing species occurrence and success. Clearly, such studies have considerable implications in conservation.

#### "Fish Community Studies"

In 1994, work continued on the fish communities of a series of lake systems. Previously-collected data were processed with respect to individual species' diets, seasonal dietary changes, relationship to changing prey resource base, and morphological adaptations. The work addresses a series of fundamental ecological questions: Are fish communities structured or are they random associations of species?; Is the guild concept viable for fish whose diets change with age and size?; Are trophic cascade models applicable to complex and seasonal systems?; Are Canadian post-glacial systems immature?; What governs the number of species and kinds of fish in a water system? These kinds of topics form the focus of the book "Trophic Ecology and Seasonal Adaptations of Freshwater Fishes", being written under contract for Cambridge University Press. At the end of last summer, the writer spent some time with European colleagues working on the Danube and Austrian alpine lake systems in comparing those communities with those of Ontario.

The writer will have the lead chapter ("Northern Temperate Freshwater Fish Communities: seasonal adaptations, use of space, age classes, diets and trophic dynamics, relative to the prey resource base") in a book titled, "Long-term Ecological Studies", being published later this year by Academic Press (Martin Cody and Jeff Smallwood, Eds.). The objective of the book is to summarize classical long-term studies on mammals, birds, reptiles and fish.

Drs. Bob Montgomerie and Pat Weatherhead (Carleton)

#### "Behavioural Ecology of American Robins"

This year we wrapped up our study of robins begun in 1986. The breeding population appears to have seriously declined around the field station and only 8 nests were found in 1994. As in past years we monitored the fate of each nest found and took blood samples from all adults and nestlings for paternity analysis.

Assistants: Dianna Kopansky, Samantha Kassel and Becky Whittam

Dr. Heather Proctor

"Female 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 multi-year project with a preliminary study on a deceptive species of orchid, *Calopogon tuberosus*. The study site was a floating bog mat near Upper Rock Lake. 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 had developed. Pods were weighed and seeds removed, counted, and checked for the presence of viable embryos. Although sample sizes were considerably reduced through rodent predation on orchids, it appeared that fresh, 1-day and 2-day old pollinia produced more seeds and heavier pods than did 4-day and 8-day old pollinia. Next season I plan to replicate this experiment on *C. tuberosus* using rodent-proof cages, and to expand the study to include other species at QUBS such as *Pogonia ophioglossoides* (deceptive) and *Epipactis helleborine* (rewarding ??).

"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 year I began 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 20 species. The mites will be sectioned and the relative volume of testes and glands reconstructed. I expect to spend at least one more summer collecting mites for this study.

"Mating behaviour of the water mite *Arrenurus manubriator* (Acari:Arrenuridae)"

Mating in the water mite *Arrenurus manubriator* is a long and elaborate procedure in which the male shakes and strokes the female before, during and after sperm has been translocated. Post-copulatory courtship in other animals has been described as a way for the male to convince the female to accept his sperm. Over a period of three years I have run experiments using videotaped courtship episodes in an attempt to determine whether any aspect of male behaviour affects the probability of a female's remating. The last of these experiments took place this summer at QUBS

where I measured the intensity and duration of male courtship when the male was given either one or two females at a time. The prediction was that males would expend less courtship energy on a given female if there was another potential mate nearby. Videotapes from this study have yet to be analyzed.

Publications:

Proctor, H.C. and B.P. Smith. 1994. Mating behaviour of the water mite *Arrenurus manubriator* (Acari: Arrenuridae). *Journal of Zoology*, London, 232: 473-483.

Proctor, H.C. 1992. Sensory exploitation and the evolution of male mating behaviour: a cladistic test using water mites (Acari: Parasitengona). *Animal Behaviour*, 44: 745-752.

Proctor, H.C. 1992. Mating and spermatophore morphology of water mites (Acari:Parasitengona). *Zoological Journal of the Linnean Society*, 106:341-384.

Dr. Laurene Ratcliffe

"Acoustic Communication and Mate Choice in Birds"

Field work in 1994 focussed on two topics (1) studies of sexually-selected signalling behaviour in black-capped chickadees (Otter, Rice, Chruszcz, Macdonald, and Cosh), and (2) tests of the acoustic adaptation and ranging hypotheses of warbler song (Fotheringham, Woodward). We also completed an interactive playback experiment designed to test the effects of frequency and temporal song matching on territorial responses of male chickadees (Ratcliffe, Fotheringham, Otter, Njegovan).

Ken Otter - "Mixed reproductive strategies of female Black-capped Chickadees" - Ph.D. Thesis

Female black-capped chickadees are known to solicit extra-pair copulations from males that rank higher than their own mate, possibly in an attempt to acquire better quality genes for their offspring. Our pilot work on eight nests in 1992 showed that extra-pair copulations result in extra-pair young, and in the three nests where extra-pair young occurred, the extra-pair males were indeed dominant to the behavioural father of the nestlings. In 1993 and 1994, I concentrated on characterizing winter dominance of males in the population, and assessing the paternity of nests in the spring to determine whether females adopt mixed mating strategies. Of the 40 nests analyzed over the three years of research, we have found that the levels of extra-pair paternity vary between years from 3/8 nests in 1992, 0/8 nests in 1994, to 4/24 nests analyzed from 1994. We are currently analysing reasons for the differences between years; variation may be a factor of the rapid onset of breeding in the late spring of 1993 reducing extra-pair opportunities for females.

During 1994 we also recorded other physical characteristics of males that females may also be using in mate assessment. The size of the under-throat bib of males, dawn chorus singing behaviour, and nest provisioning to incubating females and to nestlings are among the traits that we are assessing for correlations to dominance, and that females may use when making decisions during potential extra-pair opportunities.

Assistants: Sarah Rice, Bryan Chruszcz, Colin MacDonald, Sarah Cosh, Ruth Woodward

James Fotheringham - "Song degradation and acoustic distance estimation in Parulidae: A field test of some predictions from the Ranging Hypothesis" - M.Sc. Thesis

When a bird song passes through the environment, it is subject to distortion by sound attenuation and degradation. Some studies suggest that bird song structure has evolved to minimize distortion while passing through native habitat. Other studies, however, suggest that some species may rely on habitat-induced degradation of song to estimate the distance of singing conspecifics.



Using songs recorded from Yellow Warblers, American Redstarts, Common Yellowthroats and Ovenbirds, I conducted transmission studies to determine if these songs degrade less in native *versus* non-native habitat. I also measured the behavioural response of territorial males (n = 12 males of each species) to playback of close and distant conspecific songs to determine whether the birds were able to estimate distance using cues from song degradation. Results from the transmission studies and playback experiments will be used to test predictions of the Ranging Hypothesis (Morton 1982).

Ruth Woodward - "A test of the Acoustic Adaptation Hypothesis using songs of the Cerulean Warbler" - B.Sc. Thesis

The Cerulean Warbler (*Dendroica cerulea*) is a rare, little-studied member of the woodwarbler family (*Parulinae*). My study was designed to test the idea that selection shapes songs to transmit maximally in native habitat (i.e. the Acoustic Adaptation Hypothesis or AAH) in Cerulean Warblers. In May, 1994 I recorded singing Cerulean males, within 10 Km of the Queen's University Biological Station at Bedford Mills and Lindsay Lake. I found that a typical male sings between 1-3 different song types and there were 8 different song types in the Cerulean population studied. In June, 1994 I broadcast and re-recorded Cerulean songs at 8, 25, 50, 100 and 150 m from the speaker in a native and a non-native habitat. The native habitat was a deciduous forest near Lindsay Lake, while the non-native habitat was a red pine plantation near Chaffey's Locks. Preliminary results from computer analysis of re-recorded songs suggest that, contrary to the AAH, Cerulean Warbler song transmits better in non-native habitat. It may be that optimal transmission to biologically important receivers is more important than maximal transmission.

Assistants: Sarah Rice, Christopher Taylor

Bryan Chruszcz - "Song variation and male quality in the Black-capped Chickadee" - B.Sc. Thesis

Black-capped chickadees (*Parus atricapillus*) sing a simple, two-note, tonal song, termed a *fee bee*. Although males do not have repertoires, they have the ability to shift their songs up and down in absolute frequency. My study was designed to determine whether the *fee bee* song of the black-capped chickadee contains information that could be used to signal male quality. In April and May 1994, aided by a number of field workers, I recorded dawn choruses of 14 territorial colour-banded males at Queen's University Biological Station, Lake Opinicon, Ontario. Analysis of these songs indicates that song structure varies among males, within a dawn chorus, between the songs before and after a frequency shift, and between dominant and subordinate males. Response to playback of conspecific song also differs between dominant and subordinate males. These results indicate that the *fee bee* song of black-capped chickadee contains information that could be used as indicators of male quality.

Assistants: Colin MacDonald, Sarah Rice, Ken Otter, Ruth Woodward

#### Publications:

Fotheringham, J.R. and L. Ratcliffe. 1995. Song degradation and acoustic distance estimation in Black-capped Chickadees (*Parus atricapillus*). Can. J. Zool. (Accepted 13 Jan. 1995)

Otter, K. 1994. The impact of potential predation upon foraging behaviour of eastern chipmunks. Can. J. Zool. 72: in press.

Otter, K., M. Njegovan, C. Naugler, J. Fotheringham and L. Ratcliffe. 1994. An alternative technique for interactive playback experiments using a Macintosh Powerbook Computer. Bioacoustics 5:303-308.

Ratcliffe, L. and K. Otter. 1995. Sex differences in song recognition. Pp xxx-xxx in Kroodsma, D.E. and E.H. Miller (eds) *Ecology and Evolution of Acoustic Communication in Birds*. Cornell University Press.

Shackleton, S.A. and L. Ratcliffe. 1994. Matched countersinging signals escalation of aggression in black-capped chickadees *Parus atricapillus*. Ethology 97:310-316.

Sharman, M.Y., Robertson, R.J., and L. Ratcliffe. 1994. Vocalizations of the Tree Swallow (*Tachycineta bicolor*) during the prelaying period: a structural and contextual analysis. Am. Midl. Nat. 132: 264-274.

Zanette, L. and L.M. Ratcliffe. 1994. Social rank influences conspicuous behaviour of black-capped chickadees (*Parus atricapillus*). Anim. Behav. 48:119-127.

#### Dr. Raleigh J. Robertson

##### "Evolution of Breeding and Parenting Strategies in Birds"

In 1994, our studies on mating systems continued to examine patterns and correlates of extra-pair paternity in Tree Swallows, Eastern Bluebirds, and Eastern Phoebe. Colleen Barber spent the summer in the lab doing fingerprinting, but through the help of Taali Rooneem and Steve Hermanns, we obtained full family blood samples from the HU grid of Tree Swallows. Taali also conducted clutch manipulations as part of her BSc thesis project. These manipulations, resulting in the laying of replacement clutches, provided large families of nestlings for Christine Crossman's MSc project (P. Boag, supervisor) in which she is developing single locus probes for Tree Swallows. Martha Hiscock worked as a volunteer and followed breeding success, and obtained blood samples, from Eastern Bluebirds, and along with Kelvin Conrad, sampled blood from families of Eastern Phoebes.

##### "Effects of Forest Management Practices on Woodland Bird Communities"

The project funded by the Eastern Ontario Model Forest was expanded in 1994 to include two major components. Catherine Oliarnyk began her MSc study on Cerulean Warblers, examining nesting dispersion, density and nesting success in relation to forest habitats. Clive Goodinson provided valuable help in this study. Dale Kristensen, also for his MSc, began a study to examine the habitat values of red pine plantations for breeding bird communities. Dale got some help from Mark Hovorka, who was also at QUBS to write a manuscript on his study of fluctuating asymmetry in Tree Swallows, based on his 1993 BSc thesis. Paul Martin, who had begun the EOMF studies in 1993, focussed on bird community structure as influenced by interspecific interactions between American Redstarts and Least Flycatchers.

Assistants: Steve Hermanns, Martha Hiscock, Taali Rooneem, Mark Hovorka, Paul Martin

Colleen Barber - "Determinants of extra-pair paternity in Tree Swallows, *Tachycineta bicolor*" - Ph.D. Thesis

I am continuing to examine the adaptive significance of a mixed reproductive strategy for female and male tree swallows (*Tachycineta bicolor*). One main objective of my study is to determine why the frequency of extra-pair paternity varies so much in tree swallows, both among broods and years. Females may increase their fitness by mating with males that have "superior" genes, which may increase the viability or the attractiveness of the offspring to the opposite sex. I am examining the good genes hypothesis through DNA fingerprinting, male and female morphological and behavioural features, and male removals. A second objective is to examine the frequency of extra-pair paternity in natural cavities, to ensure that the high levels of extra-pair paternity observed in tree swallows is



not an artifact of the nest boxes or the nesting habitat. Of 25 natural-cavity females fingerprinted 84% obtained fertilizations from extra-pair males. These extra-pair males fathered 69% of a nestlings. The above results are comparable to those observed in nest-box populations. Thus extra-pair paternity is not an artifact of nest boxes or of artificial nesting conditions.

Fingerprinting was performed in the Queen's University Molecular Ecology Lab, under the supervision of Dr. Peter T. Boag. Financial support was provided by a NSERC grant to RJR, and grants from the North American Bluebird Society, the Animal Behaviour Society, the Frank M. Chapman Fund, the Sigma Xi Scientific Research Society, and the Society of Canadian Ornithologists (Taverner award to CAB).

Catherine Oliarnyk - "Breeding success and habitat use in Cerulean Warblers (*Dendroica cerulea*)"  
M.Sc. Thesis

Listed as "vulnerable" in Canada and "rare" in Ontario, the Cerulean Warbler is a species of special conservation concern. While interest in conservation of the Cerulean Warbler appears to be growing (eg. Parker, 1994; Robbins *et al.*, 1992), details of its life history, necessary for establishing management and conservation programs, are patchy and incomplete. During the preliminary season for my Master's thesis, I studied the breeding behaviour, nesting chronology, habitat use and breeding success of a population of Cerulean Warblers. Thought to be dependent on old growth forests for breeding, Ceruleans in the Lake Opinicon area are breeding successfully in mature, second-growth deciduous forest. However, initial habitat data suggest that Ceruleans are area-dependent species, vulnerable to forest fragmentation on their breeding grounds. As the breeding range of the Cerulean Warbler expands northward into maturing Ontario forests, it is important to define habitat parameters essential for continued reproductive success. Subsequent field seasons will examine the effects of forest fragmentation on this species in more detail.

This study was supported by a grant for the Eastern Ontario Model Forest Program, and would never have been possible without the help of Clive Goodinson, Mark Hovorka and Paul Martin, who identified the large population of Ceruleans in the Lake Opinicon area.

Assistants: Clive Goodinson, Mark Hovorka and Paul Martin

Dale Kristensen - "Assessing songbird habitat values of Red Pine plantations" - M.Sc. Thesis

Preliminary results of the 1993 songbird survey of conifer plantations near Lake Opinicon prompted OMNR forestry staff at Carleton Place to a further investigation of the relationship between red pine plantation management practices and songbird diversity. Queen's Biology, the OMNR, Eastern Ontario Model Forest, and the Science and Technology Transfer Unit are funding this project. This project is designed to assist in the development of alternative management protocols for conifer plantations that will boost their value as songbird habitat. Beginning this year, I established 6 study sites across Eastern Ontario, and I will be expanding the study in 1995.

Paul Martin - "Response of American Redstarts and Least Flycatchers to interspecific song playback: the role of song in interspecific aggression and interference competition" - B.Sc. Thesis

Least flycatchers (*Empidonax minimus*) and American redstarts (*Setophaga ruticilla*) overlap in the use of food resources on their breeding grounds, thus promoting high levels of interspecific aggression by the socially dominant flycatcher. We examined the role of song in this interspecific aggression by using repeated measures playback experiments and observational data on induced aggressive interactions. Flycatchers were more likely to approach the speaker during redstart song than during intervals of no stimulus or a control stimulus. Approach was close enough to enable visual contact with a singing redstart. In contrast, redstarts had significantly fewer flights made following presentation of flycatcher song, when risk of flycatcher attack may be greatest. Reducing the number of flights likely reduces the risk of flycatcher attack on the redstart, as flycatchers do not attack

stationary redstart models and are apparently dependent on cues from redstart flight for visual interspecific recognition. Flycatcher-specific responses of redstarts and marked differences in song morphology rule out misdirected intraspecific aggression as a proximate or ultimate cause of interspecific response to song. Results indicate that song is an important component in aggressive interactions between these two species, and reflect the dominant role of the flycatcher in such interactions. Our results also illustrate the capacity for interspecific interference competition to influence behavior and interspecific song recognition in two distant avian taxa. This study was in part funded by the Eastern Ontario Model Forest Group, a Taverner Memorial Award through the Society of Canadian Ornithologists, and NSERC grants to Raleigh Robertson and Laurene Ratcliffe.

Assistants: James Fotheringham, Taali Rooneem

Taali Rooneem - "The re-laying potential and laying patterns of the Tree Swallow, *Tachycineta bicolor*."  
- B.Sc. Thesis

I examined the reproductive response of energetically stressed female Tree Swallows to a predation event. Initial clutches were removed to observe which, if any, females laid replacement clutches. 41% of experimental females did lay again, and their clutch sizes were significantly smaller than initial clutches were, although clutches laid later in the season are expected to be smaller. Egg volume did not change significantly from first to replacement clutch. Female response to predation, to some extent, did vary seasonally. Inter-clutch interval did not decline with season, indicating that time of season may be relatively unimportant in influencing whether a female will re-lay. Females tended to delay laying by a day during bad weather, but weather is not likely a determining factor in re-laying. Variation in re-laying cannot be attributed to changes in food availability over the season either, since food levels are seasonally unpredictable. Female quality is most likely the determining factor for laying a replacement clutch. Although females might be exchanging future reproductive opportunities for their extra current energetic investment, they are more likely to simply be of better quality. Quality females, even under energetic stress (loss of initial clutch), do not exhibit all of the behavioural patterns expected of stressed individuals attempting to maximize reproductive success under a heavy energy load.

Dr. Kelvin Conrad - "Preliminary investigation of extra-pair paternity in Eastern Phoebes II"

This year, with the assistance of Martha Hiscock, I continued the project started in 1993 and attempted to find a better means of preserving DNA in nestling blood samples. In 1993, I successfully extracted DNA from all samples collected from adults but could only recover DNA from 36% (23/64) of nestling samples. This year we randomly assigned blood samples to be stored either in "Queen's Lysis Buffer" (QLB) or frozen in TNE2. Samples were either processed immediately or stored for up to 1 week. TNE2 samples were kept at approx. 0°C in the field in an "enzyme keeper", designed to maintain temperatures near 0°C for up to 4 hrs. Frozen samples were moved to -20°C freezer within 6 hrs and QLB samples were stored at + 4°C. We also collected blood from 2 families of Eastern Kingbirds and 2 families of Least Flycatchers. The DNA of Eastern Kingbird nestlings seems as unstable as that of Phoebes but Least Flycatcher blood stored for 1 month successfully yielded DNA. For phoebe blood, both storage systems were equally poor. After 4 days of storage, about 20% of nestling samples could not be extracted. Samples extracted on the day they were collected all produced usable DNA. DNA was successfully extracted from as little as 15 ul of nestling blood (15% of the volume usually collected). Nestling age (between 5 and 12 days) did not have any affect on success. Sufficient samples were collected to compare levels of extra-pair paternity between first and second broods of 8 families and these analyses are currently under way.

Assistant: Martha Hiscock

Martha Hiscock - "Monitoring changes in bird populations"

Nesting activity of Eastern Bluebirds and Eastern Phoebe were monitored to contribute to the long-term demographic records of these species. Eastern bluebirds have been studied consistently for 9 years. Population size this year was low, but within the limits of previous fluctuations. Eastern Phoebes reuse old nests and traditional sites have been maintained around Lake Opinicon, in some cases, for 20 or more years. Comparisons were made between current nesting activity and sites studied intensively from 1988 to 1991. The phoebe population seems to have increased slightly and a higher proportion of breeding birds now are second-year birds, suggesting a further, future increase. These data seem to be in line with current Breeding Bird Survey data.

Assistant: Kelvin Conrad

Jessie Deslauriers - "Phoebe responses to cowbirds at the nest"

In a continuing project of testing the degree of male and female Eastern Phoebe aggression toward a female Brown-headed Cowbird near a nest in the incubation stage, presentations of model female cowbirds were made at several nests. A model Song Sparrow was used in presentations as the non-threatening control. These presentations were made with and without taped recordings of cowbird and Song Sparrow songs, and were intended to test if Eastern Phoebes recognize female cowbirds as a possible threat.

"Least Flycatcher calls and possible 'honest advertisement'"

It was intended to record the number of calls made over a five minute period by individual Least Flycatchers. Time of day and temperature at one metre height were also to be recorded. The project was intended to test the hypothesis that if a male is advertising his quality as a mate, he should sing most in early morning when temperatures are cooler. If he sings when sound carries best, he should sing more in the early morning regardless of temperature. Unfortunately, for the second year in a row, the normal large resident population of Least Flycatchers failed to make an appearance.

"Spring Migration"

Mist nets were again set along the hydro lines 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".

A brief survey of the *Hepatica* population on station grounds was carried out. All *Hepatica* found were determined to be *Hepatica americana* (round-lobed). In contrast, a patch of *H. acutiloba* (sharp-lobed) was found along the road near the turn-off to the Curtis farm. These findings were reported to the Fowler Herbarium.

Publications:

Chek, A.A., J.T. Lifjeld and R.J. Robertson. 1993. Captive study of copulation in the Pied Flycatcher *Ficedula hypoleuca*. Fauna Norv. Ser. C, Cinclus 16: 67-73. (appeared in 1994)

Chek, A.A. and R.J. Robertson. 1994. Weak mate guarding in Tree Swallows: ecological constraint or female control. Ethology 98: 1-13.

Dunn, P.O., R.J. Robertson, D. Michaud-Freeman, and P.T. Boag. 1994. Extra-pair paternity in tree swallows: why do females mate with more than one male? Behavioural Ecology and Sociobiology 35: 273-281.

Dunn, P.O., L.A. Whittingham, J.T. Lifjeld, R.J. Robertson and P.T. Boag. 1994. Effects of breeding density, synchrony and experience on extra-pair paternity in Tree Swallows. Behavioural Ecology 5: 123-129 (with cover photo!).

Meek, S.B. and R.J. Robertson. 1994. Interspecific competition for nestboxes affects mate guarding in eastern bluebirds, *Sialia sialis*. Animal Behaviour 47: 295-302.

Meek, S.B., R.J. Robertson and P.T. Boag. 1994. Extra-pair paternity and intraspecific brood parasitism in eastern bluebirds revealed by DNA fingerprinting. Auk 111: 739-744.

Meek, S.B. and R.J. Robertson. 1994. Effects of male removal on the behaviour and reproductive success of female Eastern Bluebirds *Sialia sialis*. Ibis. 136: 305-312.

Rendell, W.B. and R.J. Robertson. 1994. Cavity-entrance orientation and nest-site use by secondary hole-nesting birds. Journal of Field Ornithology 65: 27-35.

Sharman, M.Y., R.J. Robertson and L.M. Ratcliffe. 1994. Vocalization of the tree swallow during the prelaying period - A structural and contextual analysis. American Midland Naturalist 132: 264-274.

Whittingham, L.A., P.O. Dunn and R.J. Robertson. 1994. Do tree swallows guard their mates by copulating frequently? Animal Behaviour 47: 994-997.

Whittingham, L.A., P.O. Dunn and R.J. Robertson. 1994. Female response to reduced male parental care in birds: an experiment in Tree Swallows. Ethology 96: 260-269.

Whittingham, L.A. and R.J. Robertson. 1994. Food availability, parental care and male mating success in Red-winged Blackbirds (*Agelaius phoeniceus*). Journal of Animal Ecology 63: 139-150.

Dr. John Smol

"Limnology"

In 1994, active use of QUBS took the form of training in techniques for research personnel working elsewhere and periodic sampling of sediments using cores and sediment traps.

Publications:

Agbeti, M.D. and Smol, J.P. 1995. Winter limnology: a comparison of physical, chemical and biological characteristics in two temperate lakes during ice cover. Hydrobiologia (in press).

Agbeti, M.D. and Smol, J.P. 1995. Chrysophyte population dynamics and encystment in two Canadian lakes. J. Phycology (in press).

Drs. Bruce Tufts and Raleigh Robertson

Heather Ferguson - "Thermal regulation of bass spawning" - M.Sc. Thesis

We studied the thermal regulation of bass spawning at three thermally different locations: Lake Opinicon, Charleston Lake and the St. Lawrence River. We found that bass spawned the earliest at Lake Opinicon, followed by Charleston Lake and lastly, the St. Lawrence River. These inter-location differences in onset of spawning are correlated with the thermal regime of the specific water body.



We also measured water temperature at many sites within each of the three locations to assess any local temperature effects on the spawning behaviour of the bass. These data will be used to demonstrate that bass spawning times can be predicted on a given year for a given body of water 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. This project was funded by the Ontario Ministry of Natural Resources and the Ontario Federation of Anglers and Hunters.

Assistants: David Bell and Cory Suski

## II: Research by Non-Queen's Students and Staff

Dr. Sherwin Desser - Department of Zoology, University of Toronto, Toronto, Ontario

Todd Smith - "The life histories, ultrastructure and taxonomic relationships among different species of *Hepatozoon* infecting snakes from Ontario" - Ph.D. Thesis

My project involves a detailed study of the development, morphology and ultrastructure of the protozoan *Hepatozoon* (Phylum Apicomplexa: Sub-order Adeleina) which infects snakes throughout Ontario. The first part of the project, which commenced in May of 1992, involved the elucidation of the life cycle of *Hepatozoon sipedon* from Northern water snakes collected in the vicinity of QUBS. During a brief visit to QUBS in July of 1993, it was apparent the *Hepatozoon* was not restricted to water snakes alone, as gamonts (intraerythrocytic sexual stages) were present in Eastern garter snakes and Eastern milk snakes. This observation has led to the second part of the project, which involves determining the life cycles, host-specificity and genetic variation of these various forms. Work done in early August of 1994 entailed collecting infected Eastern garter snakes as a source of the parasite to be used in future studies, including molecular characterization of the different forms of *Hepatozoon* and for experiments designed to test the hybridization potential of various species in the definitive mosquito host, *Culex territans*.

### Publications:

Smith, T.G., S.S. Desser and H. Hong. 1994. Morphology, ultrastructure and taxonomic status of *Toddia* spp. in Northern water snakes (*Nerodia sipedon sipedon*) from Ontario, Canada. J. Wildlife Diseases, 30:169-175.

Smith, T.G., S.S. Desser and D.S. Martin. 1994. The development of *Hepatozoon sipedon* n. sp. (Apicomplexa: Adeleina: Hepatozoidae) in its natural host, the Northern water snake (*Nerodia sipedon sipedon*), the culicine vectors, *Culex pipiens* and *Culex territans*, and an intermediate host, the Northern leopard frog (*Rana pipiens*). Parasitology Research, 80:559-568.

Dr. John Epifanio and Dr. David Philipp - Department of Fish and Wildlife, Michigan State University, East Lansing, Michigan and Aquatic Biology Section, Illinois Natural History Survey, Champaign, Illinois

### "Developmental and Regulatory Genetics of Sunfish"

In 1994 we continued to use sunfish, *Lepomis* spp., as a model for testing hypotheses concerning the causes and effects of hybridization. The timing of morphological development and expression of allozyme encoding gene loci were further investigated by constructing crosses of known parentage. The basic premise for this work is that there is a relationship between evolutionary divergence of structural genes (measured by a genetic distance of allozyme polymorphisms), regulatory genes (measured by differences and disruptions in the timing of structural gene expression) and morphological success (measured by hatching percentages, survival to yolk-sac absorption and rates of obvious physical deformity). The results from *Lepomis* will be included in a larger study that includes work previously completed for *Micropterus* hybrids (Philipp et al.) and for *Pomoxis* hybrids (Epifanio and Philipp). A secondary objective of the study was to further explore the occurrence of an anomaly in the expression of the GPI-B\* locus in sunfishes.

Assistant: Todd Kassler



Dr. Mark R. Forbes - Department of Biology, University of Regina, Regina, Saskatchewan

"Evolutionary Ecology of Invertebrates"

The main objectives of my research are to understand the factors affecting susceptibility of insects to parasites, the factors enabling adaptive host responses to parasites, the factors responsible for coexistence of two or more morphs within single populations of insects (a recently revived problem in evolutionary biology) and the factors responsible for structuring invertebrate communities. I and my students are also interested in conservation ecology of keystone prey species.

Gina Schalk and Greg Miller - "Reproductive behaviour of female morphs of the damselfly *Nehalennia irene*" - Independent Research Project

In 1994, we compared the reproductive behaviour of two female morphs of a little studied damselfly, *Nehalennia irene*. We found that males responded differentially to the two female morphs and that females differed in their responses to mate-searching males. Our results bear on the problem of differential costs and benefits to the two female morphs and, ultimately, morph coexistence in subpopulations of this species.

Publications:

Forbes, M.R.L., Richardson, J.M.L., and R.L. Baker. in press. Frequency of female morphs is related to an index of male density in the damselfly, *Nehalennia irene*. *Ecoscience* (letter from editor: 10 August 1994)

Forbes, M.R.L. and B. Leung. in press. Pre-fabricated dining shelters as outdoor insectaries: an assessment using *Enallagma ebrium*. *Odonatologica* (letter from editor: 18 January 1995)

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

"Effect of Interspecific Interactions on 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, and in particular, why populations living sympatrically with bluegill sunfish, exhibit delayed maturity and low reproductive investment relative to allopatric populations of this species. This was the second year of a whole-lake manipulative experiment designed to assess whether these differences are directly attributable to competition with bluegill. As in the previous year, approximately 200 adult bluegills were captured from Lake Opinicon and one other lake, and introduced into two small waterbodies that did not previously contain them. (We have confirmed that least one of these waterbodies now has an established bluegill population.) Pumpkinseed reproductive life history characteristics will continue to be monitored in the two experimental and two control populations over a ten year period.

Assistants: Kirk Bertschy, Vicki Stevenson, Charlotte Breadner

Kirk Bertschy - "The influence of age-specific survival probabilities on the evolution of life history traits of Pumpkinseed" - M.Sc. Thesis

The purpose of this study is to determine (1) if differences in reproductive life history characteristics at the population level are related to the ratio of adult to juvenile survival (as predicted

by life history theory); and (2) if reproductive life history differences are related to either juvenile or adult survival probabilities. Mark-recapture studies were continued for a third year in five eastern and central Ontario lakes to provide the basis for age-specific survival probability estimates. Preliminary data analysis indicates that populations with high adult survival show early maturity and high reproductive allocation, and that the shape of adult survivorship curves distinguish populations with stunted adult body size and early maturity from those with body size and maturity characteristics more typical of pumpkinseed populations in this region. There was a trend for populations with a high ratio of adult to juvenile survival to have delayed maturity and low reproductive investment, as predicted by life history theory.

Charlotte Breadner - "Phenotypic plasticity in the freshwater snail *Viviparus georgianus*" - B.Sc. Thesis

The purpose of this study is to determine whether morphological differences observed between *Viviparus georgianus* from different habitats in Lake Opinicon are a result of phenotypic plasticity. It was previously found that *V. georgianus* from rocky habitats were smaller, had denser shells and gave birth to fewer, but larger offspring than *V. georgianus* from marshy habitats. In this study, individuals were transplanted from a marsh to a rocky habitat and vice versa; they were kept in wire cages from early May until late September to complete one season of growth. Some snails were also removed and used in predation and common garden experiments in the laboratory. Information gathered in this study should indicate the degree to which life history strategies of *V. georgianus* are influenced by habitat.

Vicki Stevenson - "Assessment of juvenile Pumpkinseed and Bluegill densities in the littoral zone of lakes" - B.Sc. Thesis

The purpose of this preliminary study was to develop a method of assessing relative densities of juvenile pumpkinseeds and bluegills in the littoral zone of lakes, and to compare these densities in lakes with sympatric and allopatric sunfish populations. Five lakes of each type were selected, including Lake Opinicon, which contains both species. I tested a strip count method adapted from Keast & Harker (1977) to assess relative juvenile densities. The method appears to be successful, except that YOY pumpkinseeds and bluegills cannot be distinguished from one another in the water. To estimate these proportions in strip counts, samples of YOY were seined and identified in the lab. I plan to use this method next year as part of a study of pumpkinseed-bluegill competition for my B.Sc. Thesis.

Publications:

Fox, M. G. 1994. Growth, density and interspecific influences on pumpkinseed life histories. *Ecology* 75:1157-1171.

Danylchuk, A. J., and M. G. Fox. 1994. Seasonal reproductive patterns of pumpkinseed (*Lepomis gibbosus*) populations with varying body size characteristics. *Can. J. Fish. Aquat. Sci.* 51:490-500.

Danylchuk, A. J., and M. G. Fox. 1994. Age and size-dependent variation in the seasonal timing and probability of reproduction among mature female pumpkinseed (*Lepomis gibbosus*). *Env. Biol. Fish.* 39:119-127.

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

"Insect sensory ecology and neuroethology"

James H. Fullard and Rose Belcastro - "Comparative neuromorphology of motor neurons sound-producing versus silent moths"

I spent the summer reconstructing the profiles of stained motor neurons servicing the sound-producing structures (tymbals) in tiger moths and comparing their morphologies to the homologous neurons in silent species. Sound production in moths appears to be an extremely recent evolutionary event in the Lepidoptera and it has been difficult to determine what neuromuscular adaptations have arisen in these insects for this behaviour. By staining the motor neurons within the tymbal nerve and sectioning the central nervous system from which these cells arise, we will be able to test for predicted morphological traits such as increased cell body size, dendritic spread and axon diameter in those species that produce sound. In addition to testing ideas about how behaviours can evolutionarily arise, these morphological studies will also allow us to map out those neurons we suspect as being directly responsible for the behaviour. These maps will then permit us to locate the cells for intracellular studies planned for the next summer.

Assistant: Kathleen Pendlebury

Jeff W. Dawson - "The neural control of sound production in tiger moths" - M.Sc. Thesis

*Euchaetes egle* and *Cycnia tenera* are two closely related species of tiger moths that produce sounds by rhythmically buckling metathoracically paired tymbal organs in response to acoustic, tactile and pheromonal stimulation. I have been working at QUBS toward understanding the organization of the central pattern generator (a type of neural circuit capable of generating rhythmic behaviour) underlying this behaviour in these two moths. I have found that the tymbal CPG is located in the prothoracic ganglion and that the prothoracic ganglion is necessary for auditory evoked responses. Further, differences between these two moths suggest that the tymbal CPG is composed of paired hemioscillators, each hemioscillator controlling one of the two tymbals. I have proposed a model of the tymbal CPG in which auditory input to the prothoracic ganglion ascends to the prothoracic ganglion and then returns to the prothoracic ganglion where it activates the tymbal CPG which in turn activates the muscles of the tymbals to produce sound.

Assistant: Kathleen Pendlebury

Mark Northcott - "Sensory activation of the tymbal response in *Cycnia tenera*" - M.Sc. Thesis

I recorded the activity of auditory receptor cells in the Dogbane Tiger Moth, *Cycnia tenera*, to determine the sequence of events that trigger the tymbal response (sound production) in this species of moth. *C. tenera* is a model species for this study since it is a reliable sound producer and can be activated by only two sensory cells, the A1 and A2 cell of the moth's ear. Part of the model for the neural basis of this behaviour that has been proposed is that only one of the two cells, A2, is responsible for initiating the response. By gradually increasing the intensity of the acoustic stimulus that activates this cell, I will determine if it alone elicits the behaviour or if it acts in concert with the other cell.

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

I examined moth evasive flight behaviour after being exposed to simulated near bat ultrasound. I hypothesized that before moths engage in a sporadic, unpredictable response behaviour, they show predictable upward flight. Moths were videotaped with an infrared video camera and their flight was plotted using frame-by-frame analysis. Using this method, it will be possible to quantify average species velocities and determine angle of flight.

Assistant: Kathleen Pendlebury

Francine Lewis - "Neurometamorphosis of the ear in the gypsy moth *Lymantria dispar*, and its homologue in the earless forest tent caterpillar moth, *Malacosoma disstria*." - M.Sc. Thesis

Moths such as the gypsy moth *Lymantria dispar*, possess ears containing a two-celled auditory chordotonal organ (CO) on their metathoracic segment, but their larvae do not. The purpose of my research for my Masters degree was to determine whether the larva possessed a precursor to the adult auditory CO or if it developed as a novel structure during metamorphosis. I also investigated the development of the homologous three-celled wing hinge CO in the earless moth *Malacosoma disstria*. My research revealed that the larva of both the eared and earless species possess a three-celled precursor CO to the adult CO. The larval CO resides on the homologous larval nerve (IIIN1b1b) to the auditory nerve of the eared adult. In *L. dispar*, when the larval precursor CO is severed from the nerve before metamorphosis, the adult develops an ear lacking the auditory CO. In both species, the cells from the larval IIIN1b1b nerve project into similar areas of the central nervous system as the cells in the adult IIIN1b1b nerve. From this I concluded that the auditory CO of *L. dispar*, and its homologue in the earless species *M. disstria*, develop from a pre-existing larval CO.

#### Publications:

Dawson, J.W. and Fullard J.H. (1995) The neuroethology of sound production in tiger moths (Lepidoptera, Arctiidae). II. Location of the tymbal central pattern generator in *Cycnia tenera* Hubner. *Journal of Comparative Physiology A* (in press)

Fullard, J.H., Simmons, J.A. and Saillant, P.A. (1994) Jamming bat echolocation: the dogbane tiger moth *Cycnia tenera* times its clicks to the terminal attack calls of the big brown bat *Eptesicus fuscus*. *Journal of Experimental Biology* 194:285-298.

Fullard, J.H. (1994) Auditory changes in noctuid moths endemic to a bat-free habitat. *Journal of Evolutionary Biology* 7:435-445

Dr. M. Brock Fenton and Dr. James Fullard - Department of Biology, York University, North York, Ontario and Department of Zoology, Erindale College, University of Toronto, Mississauga, Ontario

Lalita Acharya - "Sexual dimorphism in the ears of Nearctic noctuids" - Ph.D. Thesis (York U.)

I collected data at QUBS during July and August 1994 to address the hypothesis that male moths have more sensitive hearing than females. The experiments were intended to complement some data I collected at a site in southwestern Ontario in 1993 that indicate there was male-biased predation on moths by insectivorous bats. At QUBS, I collected moths at lights or sugared bait stations, and constructed neurological auditory threshold curves (audiograms) for male and female moths of three common species. I found considerable inter-individual and inter-specific variation in auditory sensitivity, but no significant difference in inter-sexual sensitivity. These results suggest that maintaining fully functional ears is beneficial to female moths that fly (albeit less than males), since even one bat attack may result in death.

Dr. Ian Harvey and Dr. James Fullard - Department of Environmental and Evolutionary Science, University of Liverpool, Liverpool, U.K. and Department of Zoology, Erindale College, University of Toronto, Mississauga, Ontario



Karen Willson - "Fluctuating asymmetry in the ears of moths" - Ph.D. Thesis (Liverpool)

Fluctuating asymmetry (random deviations from perfect bilateral symmetry in an organism) thought to reflect an individual's ability to withstand genetic and environmental stress during development. It has been successfully applied in the field of sexual selection (e.g. Møller (1993, and refs. therein) and Harvey & Walsh (1993)), where more symmetrical males are found to be preferred by females. I investigated whether the phenomenon of fluctuating asymmetry could be applied from a more evolutionary perspective by comparing the symmetry of ears of endemic and immigrant moth in a bat-free habitat (the French Polynesian islands of Tahiti, Moorea, and Hiva Oa). If moths' ears have evolved in order to detect predatory bats, then one might expect endemic moth species, which have never encountered bats, to have more asymmetrical ears than immigrant species from islands where bats are present. Neurophysiological experiments have shown that whilst both endemic and immigrant species possess neurally responsive ears, endemic moths were significantly deafer than immigrant above frequencies of 35 kHz (Fullard, 1994). Therefore, if endemic moths had more asymmetrical ears, then this may further support the idea that the form of deafness seen reflects a release from selective pressure of bat predation. I also examined the symmetry of ears of female and male gypsy moths (*L. dispar*). As females are flightless, it might also be expected that their ears are more asymmetrical than those of males (which do fly), because there is no selection to maintain symmetry in order to detect bats. Analysis of the above projects continues and I shall return to Canada in 1995 to extend the data set and conduct neurophysiological tests on gypsy moths.

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

#### "Evolutionary and Behavioural Ecology of Fish Reproduction"

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

Luca Cargnelli - "Male reproductive behaviour and recruitment in a fish population: The Bluegill Sunfish" - M.Sc. Thesis

This project is an attempt to understand how individual male reproductive behaviour affects recruitment at the level of the population: a classic fisheries problem approached from a behavioural ecology perspective. This year I collected 1993 young-of-year that had survived the '93-'94 winter period and had not yet begun growing. By using otoliths I could count daily growth rings and determine the exact day in 1993 when each fish was hatched. Since we already know the production of fry throughout 1993, the survivors tell us the value of spawning at different times in the 1993 season. In addition, we can calculate the growth rates achieved by fry hatched at different times in 1993. Thus, the fitness value to adults from spawning in early June through July can be determined.

I also collected a sample of parental males before spawning to measure their lipid content and determine if the body size patterns we observe in male nesting behaviour can be explained by differences in energy accumulated.

This marks the second and last field season for my M.Sc. thesis. The first chapter of my thesis has already been submitted for publication.

Assistant: Jonathan Woods

Joe Justus - "The evolution and ecology of mate choice in fish with paternal care" - Ph.D. Thesis

I am using the mating system of the Pumpkinseed Sunfish (*Lepomis gibbosus*) as a model to study the evolution of mate choice in fish with parental care. This year I focused on collecting in-groups and out-groups of mate choice. I observed female pumpkinseed in the field as they swam

among courting males, making their mate choice. Once the female chose her mate, I collected that individual (in-group) and the two to five males that also courted her but were not chosen (out-group). Over fifty such collections were made and I am now analyzing the fish for parasites, condition, morphology, age, etc., to determine what cues females use in choice. I also made a number of ecological measurements of the male territories.

This marks the second field season for my Ph.D. thesis. The first chapter of my thesis has already been provisionally accepted for publication and I am currently working on chapter two. The next phase will involve experimental manipulations of male cues and tests of female choice in the experimental pool facility at QUBS.

Assistant: Erin Baker

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

David P. Philipp and Julie E. Claussen - "Natural hybridization events between Bluegill and Pumpkinseed Sunfish in Lake Opinicon"

Natural hybridization occurs between many species of fish, including bluegill and pumpkinseed. In Lake Opinicon, these two species have similarities in their reproductive seasons, as well as their habitat requirements for building nests. Research in our lab has shown that small sneaker male bluegill steal fertilizations from spawning pairs of pumpkinseed, resulting in hybridization between these two species. To determine the relative fitness of hybrids we are sampling nests of males and determining the parentage of the offspring present using molecular techniques. The results of these analysis will allow us to assess the relative costs and benefits of these hybridization events.

Assistants: Matt Deters, Todd Kassler

David P. Philipp and C. Anna Toline (INHS), and Frank Phelan, Queen's University Biological Station - "Catch-and release angling of Largemouth and Smallmouth Bass"

Although preseason catch-and-release angling is a common practice, little is known about its impacts on the reproductive success of bass. To measure these impacts, researchers angled parental male largemouth and smallmouth bass off their nests sites and determined the time it took to return to the nest site, as well as the subsequent abandonment rates. During the angling, aspects of the 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 the St. Lawrence River, Charleston Lake, Lake Opinicon, and other sites.

Assistants: Todd Kassler, Cory Suski, Dave Bell

David P. Philipp and C. Anna Toline (INHS), and Frank Phelan, (QUBS) - "Spawning dynamics of stream Smallmouth Bass"

In the Mississippi River (Ontario), the area between Ragged Chute and Miller Lake has historically had high concentrations of smallmouth bass, although little is known about their spawning dynamics within a season and among years. To monitor the mating and reproductive success of smallmouth bass and their movements in this portion of the river, 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 fidelity are being assessed.



Assistants: Todd Kassler, Vince Tranquilli

David Philipp (INHS) and Frank Phelan, (QUBS) - " 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 behaviors in both species continued to be documented at Lakes Opinicon and Charleston, and 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: David Bell, Heather Ferguson, Cory Suski

Publications:

D.P. Philipp and M.R. Gross. 1994. Genetic evidence for cuckoldry in bluegill *Lepomis macrochirus*. *Molecular Ecology* 3:563-569

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

"Water Mite Parasitism of Aquatic Insects"

I. Reproductive tactics and loss of parasitism within *Arrenurus* spp. mites

A. 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 large numbers of small eggs that result in parasitic larvae while females of the other sibling species produce small numbers of large eggs that result in larvae that forgo feeding and hence do not take a host. In 1993, Seth Ettenberg and I tested for reproductive isolation within sibling pairs. Crosses of females from the lineage with non-feeding larvae with males from the lineage with parasitic larvae resulted in offspring that did not need to feed as larvae, but had morphology typical of parasitic larvae: almost all matured to adult stage. Offspring from the reciprocal cross (female from the lineage with parasitic larvae and male from the lineage with non-feeding 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. We concluded that apparent asymmetrical success in development to adult represents partial reproductive isolation between species within each sibling species pair. In 1994 I conducted breeding experiments involving backcrosses of the F1 hybrids. Hybrid females produced eggs intermediate in size between the small eggs of the lineage with parasitic larvae and large eggs of the lineage with larvae that forgo feeding. Larvae resulting from backcrosses of hybrid females could complete development and transform into deutonymphs without a parasitic relationship, but the resultant deutonymphs were smaller and had difficulty catching prey, hence had lower survival. In the one species pair, the backcross of hybrid females to males of the lineage with parasitic larvae resulted in offspring that could transform into deutonymphs without feeding but would parasitize a host if it were available.

Dr. Bruce P. Smith and Dr. Heather Proctor - Department of Biology, Ithaca College and Department of Biology Queen's University

B. "Skewed sex-ratios in *Arrenurus manubriator*"

In 1994 we raised offspring from field-collected females of *Arrenurus manubriator* to determine whether there was a skewed sex ratio in progeny of a female, both within and among clutches. This had previously been demonstrated by Heather and also by Eric Bran (Ithaca College undergraduate) with mites from the laboratory colony, but it was not clear whether this was representative of the species in nature. Progeny from 8 of 10 females had strongly biased sex-ratios, as high as 33 females to no males. Bias was consistent among clutches within female (taken to 5 clutches per female). In tests using 5th generation lab colonies, the overall sex ratio was 2♂:3♀ in both cases, while field-collected females produced offspring with an overall sex ratio of 1♂:1♀. It is possible that the skewed sex ratio in laboratory colonies is an artifact from selection pressures intrinsic to culturing the species in the lab.

Dr. Bruce P. Smith and Andrew J. Bohonak - Department of Biology, Ithaca College and Department of Ecology, Cornell University

II. "Population genetics and systematics of *Arrenurus* spp. water mites"

We are conducting an allozyme analysis of water mite species in the genus *Arrenurus* from northeastern North America. Genetic differentiation among populations should be correlated with geographic distance among populations and the method of dispersal used by the mite species. 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-mediated dispersal) 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.

In addition, we hope to use these genetic data to test the validity of certain species, and as an indication of phylogenetic relatedness among species. Several thousand water mites were collected in 1994 throughout the lakes, rivers, and swamps in the vicinity of the Queen's University Biological Station and the Wildlife Research Station of Algonquin Park. Background genetic screens conducted on females identified only to genus have produced 13 putative loci which can be reliably scored. Of these, at least 11 loci show variability that will be useful for differentiating species and/or populations.

Publications:

Proctor, H.C., and B.P. Smith. 1994. Mating behaviour of the water mite *Arrenurus manubriator* Marshall (Acari: Arrenuridae). *Journal of Zoology, London*, 232: 473-483.

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

"Long-term Studies of Birds and snakes"

In 1994 the long-term studies of red-winged blackbirds (16 years), black rat snakes (14 years), and northern water snakes (7 years) were continued. All the specific studies that were undertaken this year were done as part of thesis research by my students and are described below.

Assistant: Kit Muma

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 1994, we continued 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 snakes was supplementally-fed at regular intervals to determine how extra resources would affect their temperature selection, growth and activity.

Assistants: Perry Comm, Melanie Prosser

Perry Comm - "Mating behaviour of captive northern water snakes" - B.Sc. Thesis

Observations of northern water snakes in the field indicate that competition among males for access to females is intense, which should result in selection for those traits that enhance male mating success (see Greg Brown's research above). To observe the outcome of competition among males under more controlled conditions, reproductive females were housed with several males selected for their size. Using the tanks in the Aquarium Building allowed videotaping of the ensuing competition and mating. These tapes are being analyzed to determine which male attributes contribute to male mating success and whether these patterns appear to be consistent with the less detailed observations made in the field.

Kevin Dufour - "Bilateral symmetry and reproduction in red-winged blackbirds" - Ph.D. Thesis

In 1993, I initiated a study to examine the reproductive (i.e. fitness) consequences of minor developmental inconsistencies (manifested as asymmetry in bilaterally paired morphological characters) for individual male red-winged blackbirds. Work on this project continued in 1994 and was comprised of three main components: (1) continued monitoring of redwing breeding activity at several marshes at and around QUBS, with the aim of determining the relationship between asymmetry and the annual reproductive success among territorial males, (2) use of a male removal experiment to determine whether asymmetry influences territory acquisition, and (3) use of aviary trials to assess the relationship between asymmetry and overall male competitive ability. Results of the project are pending data analysis.

Assistant: Kit Muma

Kent Prior - "Conservation biology of black rat snakes" - Ph.D. Thesis

The black rat snake is a rare species in Ontario. They persist in three or four geographically isolated, relict populations, the largest of which occurs in the Rideau Lakes Region. This research is aimed at providing a variety of ecological and genetic data critical to their conservation. Continued monitoring of eight hibernacula across the Rideau Lakes Region during spring of 1994 allowed further data collection on emergence patterns, hibernacula demographics and habitat use and the opportunity to complete blood sampling for genetic analyses. Preliminary analyses of the genetic structure and diversity found within the Rideau Lakes population(s) have been made using randomly amplified polymorphic DNA (RAPD) markers. Comparisons will be made between this population and those sampled in southern Ontario, Maryland and Arkansas in order to assess the role that population size, isolation and gene flow play in determining genetic variation. Genetic analyses are being done in collaboration with Dr. H. Lisle Gibbs (McMaster University).

Assistant: Terri Taylor

Melanie Prosser - "Male mating success relative to sexual size dimorphism in northern water snakes" - Ph.D. 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. Single-locus probes are currently being developed for evaluating male mating success in northern water snakes. These methods will be applied to broods produced by females mated in captivity (see Perry Comm's research above) to address questions such as the effect of mating order or size differences on male success. The methods will also be applied to broods produced by females mated under natural conditions in the wild (see Greg Brown's research above) to assess hypotheses proposed to explain why males are substantially smaller than females despite intense mating competition.

Assistant: Perry Comm

Stephen Yezerinac - Plumage variation and extra-pair mating in yellow warblers - Ph.D. Thesis

Yellow warblers exhibit substantial variation in plumage brightness. Previous studies showed that this variation was correlated with male parental and territorial behaviour, but unrelated to reproductive success. This study was initiated to test the hypothesis that social monogamy actually conceals a system of genetic polygamy in which extra-pair fertilisations increase the reproductive success of brighter males at the expense of duller coloured males. Three years of field study have now been completed. Results from DNA fingerprinting reveal that extra-pair fertilisations occur in roughly 60% of families and that about 30% of all offspring are the product of extra-pair matings. These extra-pair fertilisations dramatically increase the opportunity for sexual selection and preliminary results (first 2 years data) suggest that more brightly coloured males are indeed more successful philanders. Influences other than male plumage on extra-pair matings, such as timing of breeding and male behaviour, are also being examined. Genetic analysis of the third year's data is nearing completion, bringing this project to its end.

Assistant: Terri Taylor

Publications:

Forbes, M.R.L. and K.L. Teather 1994. Variation in male responses to two female morphs in the damselfly *Enallagma ebrium* (Hagen). *Odonatologica* 23:103-114.

Forbes, M.R.L., P.J. Weatherhead and G.F. Bennett. 1994. Blood parasites of the blue grouse: variation in prevalence and patterns of interspecific association. *Oecologia* 97: 520-525.

Gibbs, H.L., K.A. Prior and P.J. Weatherhead. 1994. Genetic analyses of populations of threatened snake species using RAPD markers. *Mol. Ecol.* 3:329-337.

McRae, S.B., P.J. Weatherhead and R. Montgomerie. 1993. American robin nestlings compete by jockeying for position. *Behav. Ecol. Sociobiol.* 33:102-106.

Metz, K.J. and P.J. Weatherhead. 1993. An experimental test of the contrasting-color hypothesis of red-band effects in red-winged blackbirds. *Condor* 95: 395-400.

Scribner, S. and P.J. Weatherhead. 1995. Locomotory ability and predator avoidance in three species of semi-aquatic snakes. *Can. J. Zool.*, in press.



Shutler, D. and P.J. Weatherhead. 1994. Movement patterns and territory acquisition by float red-winged blackbirds. Can. J. Zool. 72: 712-720.

Teather, K.L. and P.J. Weatherhead. 1994. Allometry, adaptation and the growth and development of sexually dimorphic birds. Oikos, 71: 515-525

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., in press.

Weatherhead, P.J. 1994. Mixed reproductive strategies by females may strengthen the sexy sex hypothesis. Anim. Behav. 1210-1211

Weatherhead, P.J. 1995. Effects of familiarity and experience among male red-winged blackbirds on female reproductive success. Anim. Behav., in press.

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., in press.

Weatherhead, P. J. and P. T. Boag. 1995. Pair and extra-pair mating success relative to male quality in red-winged blackbirds. Behav. Ecol. Sociobiol., in press.

Weatherhead, P.J. and R.G. Clark. 1994. Natural selection and sexual size dimorphism in red-winged blackbirds. Evolution 48: 1071-1079

Weatherhead, P.J. and M.R.L. Forbes. 1994. Natal philopatry in birds: genetic or ecological influences? Behav. Ecol. 5: 426-433.

Weatherhead, P.J., K.J. Metz, G.F. Bennett and R.E. Irwin. 1993. Parasite faunas, testosterone and secondary sexual traits in male red-winged blackbirds. Behav. Ecol. Sociobiol. 33: 13-23.

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., in press.

Weatherhead, P. J. and R. Montgomerie. 1995. Local resource competition and sex ratio variation in birds. J. Avian Biol., in press.

Weatherhead, P.J., R. Montgomerie, H.L. Gibbs and P.T. Boag. 1994. The cost of extra-pair fertilizations to female red-winged blackbirds. Proc. R. Soc. Lond. B 258: 315-320.

Weatherhead, P.J. and K.L. Teather. 1994. Sexual size dimorphism and egg size allometry in birds. Evolution 48: 671-678.

Yezerinac, S.M. 1993. American redstarts using yellow warblers' nests. Wilson Bull. 105: 529-531.

Yezerinac, S.M. and K.W. Dufour. 1994. On testing the Hamilton-Orians hypothesis for the origin of brood parasitism. Condor 96:1115-1116.

Yezerinac, S.M. and P.J. Weatherhead. 1995. Plumage coloration, differential attraction of vectors, and haematozoa infections in birds. J. Anim. Ecol., in press.

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., in press.

# Documentation of Use of QUBS in 1994 - User-Days

User	Supervisor	Post-Doc	Graduate Student	Assistant	TOTAL
<b>INTERNAL (QUEEN'S) RESEARCH</b>					
Aarssen	10	0	10	60	80
Briskie	4	0	0	0	4
Cumming	2	0	0	2	4
Eckert	23	0	0	23	46
Harmsen	16	0	50	159	225
Keast	35	0	0	0	35
Montgomerie	8	0	0	119	127
Phelan	n/a	0	0	162	162
Proctor	115	0	0	0	115
Ratcliffe	2	0	157	215	374
Robertson	84	10	133	396	623
Smol	0	0	0	7	7
Tinline	2	0	0	49	51
Tufts	2	0	45	0	47
Total Internal	303	10	395	1192	1900
<b>EXTERNAL RESEARCH</b>					
University of Toronto					
Desser	0	0	5	0	5
Fullard	70	0	254	161	485
Gross	6	0	35	22	63
Carleton University					
Weatherhead	40	0	385	283	708
Illinois Natural History Survey					
Philipp	45	65	0	47	157
University of Regina					
Forbes	7	0	0	26	33
Ithaca College					
Smith	84	0	0	5	89
Trent University					
Fox	0	0	9	6	15
York University					
Fenton	0	0	54	0	54
Michigan State					
Epifanio	22	0	0	0	22
University of Liverpool					
Harvey	0	0	35	0	35
Cornell University					
Bohonak	0	0	59	0	59



*Documentation of Use of QUBS in 1994 - User-Days (continued)*

User	Supervisor	Post-Doc	Graduate Student	Assistant	TOTAL
Total External	274	65	836	550	1725
Total Research User-Days	577	75	1231	1742	3625
% Queen's	53	13	32	68	52
% Non - Queen's	47	87	68	32	48

USER-DAYS IN TEACHING ACTIVITIES 2628

CONFERENCE AND FIELD TRIP USE 665

OTHER\* 1110

GRAND TOTAL USER-DAYS IN 1994 8026\*\*

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

(\*\* up 7% from 1993)

*Summary of Conference, Meeting and Field Trip Use of QUBS in 1994*

Organizer	Function	Number of Participants	Duration
Dave Bell and Heather Ferguson (Queen's - Biology)	Reunion Weekend	22	Jan. 14-16
Floyd Connor (QUBS)	Costa Rica Reunion	11	Jan. 22-23
Dr. R. Harmsen (Queen's - Biology)	Bio 528 (Population Ecology) Weekend	13	Jan. 28-30
Nadine Daguiar (Queen's - Law)	Queen's Environmental Law Association Meeting	16	Mar. 4-5
Darlene Lim (Queen's - OPID)	Queen's Program in International Development Weekend	29	Mar. 12-13
Mark Millan (Lancaster Public School)	Canoe Trip and Station Tour	25	June 15
Mark Millan (Lancaster Public School)	Canoe Trip and Station Tour	25	June 17
Alex Palilionis (OMNR - Kingston)	American Fisheries Society S. Ont. Chapter Executive Meeting	7	June 18-19
Caroline Benedek (Queen's)	Science Discovery Training Session	8	June 23
Caroline Benedek (Queen's)	Science Discovery Field Trip	30	July 7
Caroline Benedek (Queen's)	Science Discovery Field Trip	26	July 21
Susan Crispin (The Nature Conservancy)	Alvar Workshop	16	July 21-23
Caroline Benedek (Queen's)	Science Discovery Field Trip	26	Aug. 4
Colin Gaskell (Ottawa Field Naturalists)	Ottawa Field Naturalists Field Trip and Picnic	43	Aug. 7
Caroline Benedek (Queen's)	Science Discovery Field Trip	25	Aug. 18
Stephen Virc (E. Ontario Model Forest)	EOMF Board Meeting and Workshop with Forestry Canada	26	Aug. 23-24
Dr. Ed Kott (Wilfrid Laurier-Biology)	Wilfrid Laurier Senior Undergraduate Field Course	23	Aug. 28-Sept. 10

Organizer	Function	Number of Participants	Duration
Don Cuddy (OMNR - Kemptville)	Wetland Plant Identification Workshop - Group 1	22	Sept. 6-7
Don Cuddy (OMNR - Kemptville)	Wetland Plant Identification Workshop - Group 2	15	Sept. 8-9
Steve Thompson (Sir Sandford Fleming)	Terrain and Water Resources Field Course - Group 1	39	Sept. 12-14
Steve Thompson (Sir Sandford Fleming)	Terrain and Water Resources Field Course - Group 2	41	Sept. 14-16
Andrew Pirie (Queen's - Biology)	Bio 302 (General Ecology) Weekend - Group 1	68	Sept. 17-18
Andrew Pirie (Queen's - Biology)	Bio 302 (General Ecology) Weekend - Group 2	68	Sept. 24-25
Andrew Pirie (Queen's - Biology)	Bio 302 (General Ecology) Weekend - Group 3	57	Oct. 1-2
Dr. John Smol (Queen's - Biology)	Bio 335 (Limnology) Field Trip - Group 1	46	Oct. 1
Dr. John Smol (Queen's - Biology)	Bio 335 (Limnology) Field Trip - Group 2	51	Oct. 2
Ross Cholmondeley (OMNR - Brockville)	Bass Workshop - Bass Management in Ontario	39	Oct. 2-4
Dr. Ed Kott (Wilfrid Laurier - Biology)	Fish Ecology Field Trip	22	Oct. 7-10
Larry Harbidge (St. Lawrence Islands National Park)	FASTLINE Workshop (Frontenac Axis - St. Lawrence Inventory Network on the Environment)	25	Oct. 20-21
Ross Hawkins (South Crosby Public School)	Grades 7 and 8 Pond Study Field Trip	45	Oct. 21
Dr. Victoria Remenda (Queen's - Geology)	Hydrogeology Weekend Group 1	49	Oct. 22
Dr. Victoria Remenda (Queen's - Geology)	Hydrogeology Weekend Group 2	47	Oct. 23
Annette (Queen's - Law)	Queen's Environmental Law Association Weekend	14	Oct. 29-30
James Nesbitt (Queen's)	ASUS Leadership Workshop	8	Nov. 5-6

### Seminar Schedule 1994

May 13	Dr. Michael Schunk (Director of Animal Care Services, Queen's University) "Use of animals as field and lab study organisms: animal care considerations"
May 18	Dr. David Philipp (Illinois Natural History Survey) "Conservation genetics and current fish stocking practices: Are they compatible?"
May 24	Dr. Gray Merriam (Department of Biology, Carleton University) "Forest fragmentation and corridor use by small mammals"
June 8	Anna Toline (Department of Zoology, University of Toronto) "Dace: How different are they?/How'd they get that way?"
June 15	Dr. Heather Proctor (Department of Biology, Queen's University) "Ask me, I mite: Male strategies for gamete-packaging and transfer"
June 22	Dr. John Epifanio (Department of Natural Resources, Michigan State University) "Estimating population admixtures from genetic data"
June 29	Greg Brown (Department of Biology, Carleton University) "Snapping Turtles: Behavioural and physiological ecology"
July 7	John Mitchell (Earth Images Foundation) "Through my lens: a photographic smorgasbord"
July 14	Turid Holldobler-Forsyth "Art in Nature/Nature in Art" A special illustrated seminar sponsored by the Pearl E. Williams and Llewellyn Hillis Fund
Aug 19	Dr. James Fullard (Department of Zoology, Erindale College of University of Toronto) "The Wonderful World of Bats" A special seminar, part of the "Friends of Opinicon" summer program
Sept 2	Turid Holldobler-Forsyth "Art in Nature/Nature in Art" A special illustrated seminar sponsored by the Pearl E. Williams and Llewellyn Hillis Fund and in conjunction with "Friends of Opinicon"



## Fee Schedule for 1995

### Board Charges - Meals only

\$418/month/person

\$290/month/person

-no obligation for chores

-includes obligation for chores on a rotating schedule

### Accommodation Charges - Housing only

\$16/month/person

\$32/month/person

\$64/month/person

\$86/month/person

\$118/month/person

-dormitory (White House or Curran Cottage)

-small cabin (Bunkie Jrs., shaker and Basswood Cabin)

-medium cabin (Cabins 3, 8, 9, 10, 14)

-large cabin (Cabins 12, 15 and White House Apartment)

-Cottage (Keast, Earl, Sumac or Maplewood)

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

\$175/person

\$21.50/day/person

\$4.00

\$7.50

\$9.00/person

\$18.50/person

-weekly R&B for field courses - includes a lab fee

-24 hr. room and board

-breakfast or lunch only

-dinner only

-overnight accommodation - academic purposes

-overnight accommodation - non-academic purposes

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

### Boat Rental

\$190/month, \$87.50/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

\$4.50/day - non-Queen's staff or major researcher (M.Sc. or Ph.D. candidate, project coordinator or Post-Doctoral Fellow)

\$1.55/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.