

Queen's University Biological Station Annual Report and Newsletter

1993



Director: Dr. Raleigh J. Robertson

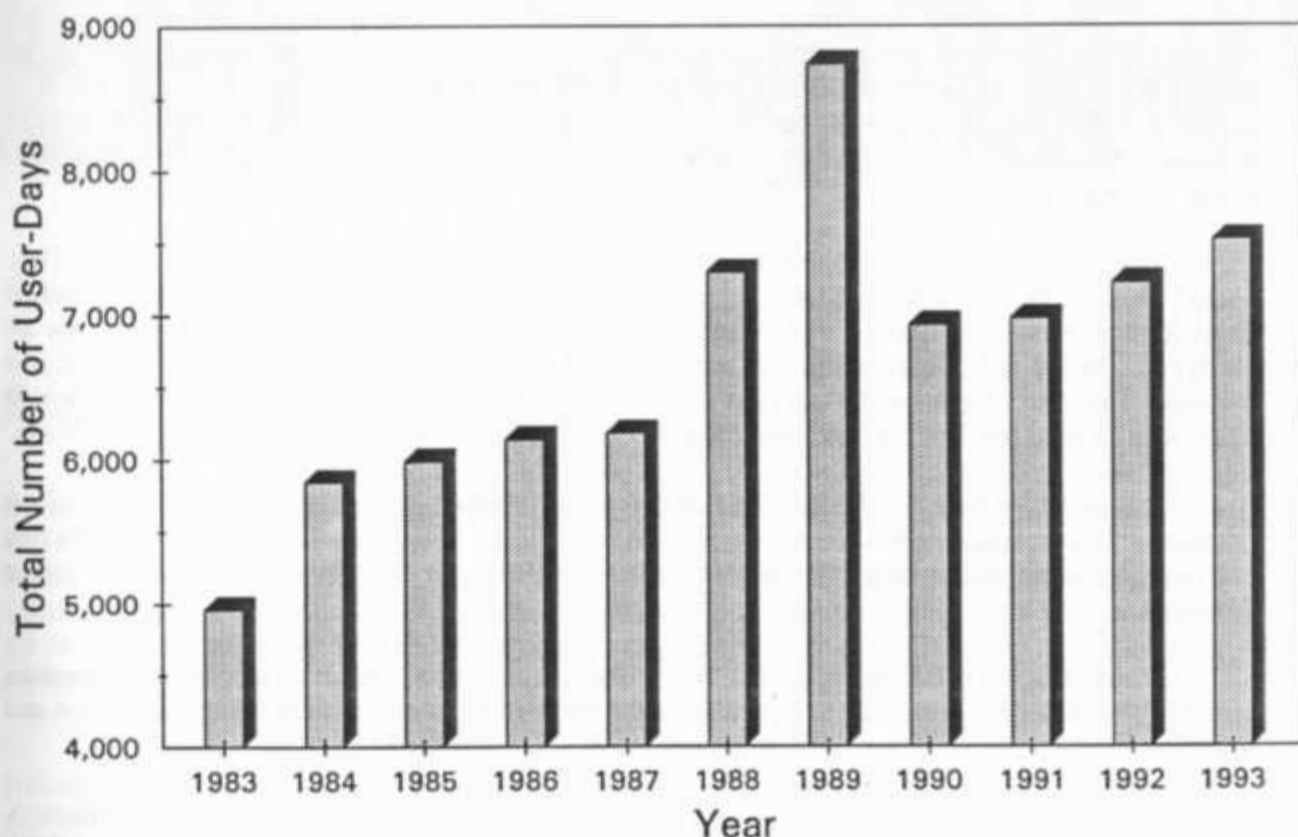
Manager: Frank J.S. Phelan

Introduction

Nineteen ninety-three was another successful and busy year at Queen's University Biological Station. User-days were up slightly from 1992 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 eight weeks of modules in the Ontario Universities Program in Field Biology. 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. Steve Thompson (Sir Sandford Fleming) brought his natural resources field course to QUBS in late April. Dr. Ed Kott (Wilfrid Laurier) brought his field course for senior undergraduates to QUBS for two weeks in late summer. The fifteenth edition of the Naturalists' Workshop, described in more detail later in this report, was held in late May.

Over the last decade, use of QUBS has been increasing. The figure below illustrates the changes in total number of user-days at QUBS over the past 11 years.



Comparing 1983 levels with 1993 levels, overall use has increased by 58%. With the exception of 1989, growth has been steady over this interval.

The demand for small conferences and workshops continues to expand. 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 1993 appears later in this report.

Ellen Bonwill

[reprinted from *This Week in Biology*, 2 August, 1993]

Ellen Bonwill, a writer, educator, and above all, a committed naturalist and conservationist, passed away on Sunday, 25 July 1993. Ellen and her husband Allan made a very significant contribution to Queen's by making available nearly 1,000 acres of Skycroft land to become part of the Queen's University Biological Station.

Ellen and Allan became involved in natural history and education through their activities in scouting, and as teachers. They started visiting the Lake Opinicon area in summers, from their home in Maryland, during the 1940's. In the 1950's, with encouragement from John and Maybelle Hughson, they founded Skycroft, a family camping and outdoor education centre, on a tract of over 1,000 acres of land on Lake Opinicon. From their home in Connecticut, where Ellen wrote a column *Along the Nature Trail* for the New Haven Register and was active in many education and natural history programs (including some at Yale, where Floyd Connor and I first met the Bonwills in about 1969) and Allan was a teacher at East Haven, they developed their summer programs at Skycroft. In the early 70's, they moved their full-time residence to Skycroft, where they were later joined by their daughter Ann and son-in-law Jim Barton.

Ellen and Allan had a lifetime commitment to conservation and natural history education. They wanted Skycroft to help them fulfil this commitment in the future. In about 1984, they approached Queen's about a possible lease to own arrangement, so they could ensure that the land would not be developed. In the end, Queen's made an outright purchase of nearly 1,000 acres for a price of just \$50,000. That land, the Bonwill Tract, was dedicated in 1986 as part of the Biological Station. It will continue to be used for field courses, research and conservation education for the very long term future.

It is perhaps fitting that Ellen is the first person to be buried in the new section of the Opinicon Cemetery. The expansion of this cemetery was made possible at the suggestion of the Bonwills some five years ago, by a contribution of a small parcel of land on the Hughson Tract from Queen's to Storrington Township.

Many of us at QUBS will miss Ellen as a friend and neighbour. All of us owe her a tremendous debt of gratitude for her generosity to Queen's and for her lifetime commitment to both conservation and education.

Raleigh J. Robertson
Director, QUBS

The Bonwills have always called the island in Telephone Bay, north of the Opinicon Road, Ellen's Isle. We propose to keep that name as the official island name as a tribute to Ellen Bonwill.



Dedication of Bonwill Tract, July 1986: Charles Sauriol, Dr. Raleigh Robertson, Ellen and Allan Bonwill

Back Lakes Tract

Last fall, Raleigh and Frank launched an initiative to acquire the "Back Lakes Tract" from the Rock Lake Cooperative Association (RLCA). Revised tax assessment procedures have caused property taxes paid by the RLCA to soar in recent years. This change in financial picture has caused the association to look carefully at its landholdings and to offer remote and little-used properties for sale. Consequently, the "Back Lakes" property has been listed for sale for some time. The initial asking price for the property exceeded \$2,000,000. Upon entering into negotiations, a mutually agreeable price of \$540,000 was reached.

The property is some 1500 acres in extent, enclosing six small lakes and a variety of forest and wetland habitat. The "Back Lakes" property is bounded on the north by the Bonwill Tract and on the east and south by arms of the Hughson Tract of Queen's University Biological Station. This acquisition would consolidate QUBS landholdings and allow a significant block of interesting property to remain in an undeveloped state.

The objective of this acquisition is to obtain for conservation purposes and biodiversity and management studies a unique 1500 acre tract of forest, swamp forest, lakes and wetlands, adjacent to

2000 acres of forest, regrowth forest, reverting farmland and beaver pond habitat already owned by Queen's University. The mature forests of the tract provide vital habitat for the Cerulean Warbler, an endangered species (featured on the front cover of this report). Many other species of neotropical migrants are also found within the property. In addition, the wetland areas, the lakes and associated beaver pond complexes are key habitats for a variety of species. It is proposed that this tract be acquired and preserved as a **Conservation Area for Warblers, Wetlands, Science and Education**.

Because of the size of the project and the capital involved, we are trying to build a large partnership to enable the purchase. Raleigh and Frank have made contact with, and are applying to, a spectrum of philanthropic organizations. Recently, Charles Sauriol, veteran conservationist, has agreed to assist with fundraising for this project. With Mr. Sauriol's contacts and experience, we anticipate steady progress toward our goal.

To date, we have submitted applications to:

Ontario Heritage Foundation
Eastern Habitat Joint Venture
Endangered Species Recovery Fund (World Wildlife)
Eastern Ontario Model Forest

Applications are pending to:

Wildlife Habitat Canada
Nature Conservancy of Canada
Canadian National Sportsmen's Shows
Cataraqui Region Conservation Foundation
Ducks Unlimited
Conservation International

We have some funds in hand from Friends of Opinicon and the Opinicon Appeal.

Meanwhile, Frank has been negotiating the terms of the offer of purchase and sale with the RLCA. The details are very nearly hammered out. The offer will give us until July 1994 to put together the purchase price from our funding partners.

1993 Renovations and Additions

In 1993, a number of changes and improvements were made to QUBS facilities. These included: (1) Maplewood Cottage was completed for use by May. This cottage, located overlooking Stumpy Bay, just northeast of Sumac Cottage, has two bedrooms, a bathroom and a livingroom/diningroom/kitchenette. Occupants were impressed with its layout, comfort and charm. It will be an asset in handling demands for space from senior researchers and small families. (2) In late summer, a cedar deck was added to the front of Maplewood Cottage. Currently, the cottage is fully complete with the exception of some landscaping over and around the septic system. Hopefully, this will be looked after in 1994. (3) In early spring, while readying the lodge for summer, it was discovered that winter snows had caused considerable stress to the roof of the lodge. Indeed, it was so bad that we sought advice from Campus Engineering

Services. Mr. Bob Hewitt inspected the roof and offered suggestions on bracing it up for the time being. These repairs (adding gussets to the roof rafters, splicing new material to stressed and cracked rafters) were carried out before the field season began. Given the state of the roof, Mr. Hewitt suggested that the only really meaningful repair was total replacement of the roof. This would not be feasible atop the present walls and non-existent footings, so replacement of the entire building seems the only permanent option. (4) A number of alterations were aimed at keeping the lodge cleaner. In summer, we added a triangular entrance deck outside the porch entrance, to keep mud, sand and dirt at bay. The addition of eavestrough over this entrance and deck also helped keep things drier. At the rear entrance, a similar eavestrough was welcomed by staff especially, whose repeat trips to the storeroom in rainy weather were always an adventure. (5) In spring, we removed the small wall sink from the men's bathroom in the lodge and replaced it with a counter and recessed sink. This has greatly improved the layout of the washroom and provides extra space for toilet articles etc. (6) All new countertops were installed in the lodge kitchen and food service area. This was much needed around the sinks in the kitchen. Replacing all the countertops with Formica in a wood-grain pattern has greatly improved the looks and the sanitary nature of these surfaces. (6) The hard winter caused some leaks in the old plumbing to the lodge kitchen. Consequently, we replaced the old lines with new copper and insulated all of the hot water lines. (7) In an attempt to prevent easy access by mice to the lodge, all accessible cracks, holes and spaces were covered over, repaired or sealed. (8) The final touches in the renovation of Basswood Cabin were applied before the season. Vinyl floor coverings, window shades, shelves, closet rods and desks were installed. This duplex cabin was used for the first time this summer. (9) With the help of Bruce Cameron, improvements were made to the Rappinicon. A new swim platform made of aluminium tubing and sheet was added to the front. The starter was rebuilt. A second bilge pump was installed as a safety measure. The wooden storage compartment was removed and replaced with a portable aluminium storage bench. This arrangement allows greater working space up front of the wheel. We also rebuilt part of the huge trailer, adding a new, beefy tongue and new wheel bearings on all wheels. (10) With the assistance of Ron Vinkle and Jay Phelan, the Boathouse was scraped and repainted in summer. (11) The edge of the path to the Boathouse was reconstructed, replacing the eroded margin near the boat racks. In addition, a metal safety rail was added to prevent the possibility of stepping off the path. Now it is possible to use the safety rail from the curve of the path near the old tankhouse right on into the Boathouse. (12) The roof of cabin #1 was stripped, repaired and reshingled to stop its leaks. (13) Several of the concrete floors were repainted in fall to make ready for spring of 1994. This included the rear of the lodge and the Trilab. (14) With Faculty equipment funds awarded to the field station in 1993, a new grader blade (Arps - 8') and a custom-built tandem axle hydraulic dump trailer (Del-Rae) were purchased. The heavy-duty grader blade simplifies road maintenance and light snow removal. The dump trailer should ease trash handling and disposal and make carrying wood, dirt and gravel much simpler than in the past. (15) In fall, a class C hitch was added to the work truck, necessitated by the acquisition of the dump trailer. In addition, a sheet of checker-plate was installed in the bed of the truck to cover the rust-holes. (16) Two 386 IBM computers were obtained this fall from Queen's/IBM GIS (Geographic Information System) lab through Dr. Rollie Tinline. These computers will add two workstations to the existing computing facilities at QUBS. With the proper external hard-drive, one of these computers can become the heart of any GIS at the field station. (17) Repairs were made to the New Barn. Replacement siding boards were installed to replace those prised off and stolen by 'barn board' aficionados. Repairs were made to the main door and to the roof of the equipment lean-to on the south side. (18) Our old rotary mower literally shook to pieces during mowing of the fields on the new land, so in fall a new Bush Hog was purchased. Hopefully, this one will last. (19) We continued to repair, reputty and repaint windows and screens on the lodge. (20) Rod, Floyd and Frank worked hard to clean up the fallen trees from the windstorm last fall. The mess was cut, split and stacked in the woodshed in such quantity that no further space is available. However, on the bright side, we probably have enough wood for fireplaces and barbecues for a couple of years. (21) The last remains of the old sauna were removed in 1993. (22) A large, three-compartmented composter was purchased and put into service in mid-summer.

GIS Project - Principal's Development Fund

Drs. Raleigh Robertson (Queen's - Biology) and Rollie Tinline (Queen's - Geography - Queen's/IBM GIS lab) were awarded a grant through Category A of the Principal's Development Fund in 1993. This grant was to prepare a digital base map of QUBS properties and to lay the foundations for a GIS (Geographic Information System) to be housed at the field station. Using topographic maps, the 1:10000 Ontario base maps, available property surveys and metes and bounds descriptions, preliminary mapping was done. Tammy Peters (Mendrisky) was employed to prepare the maps. In the field, GPS (Global Positioning System) hardware and software was employed to fix major features of the properties. With few real surveys available and working from metes and bounds descriptions, many anomalies surfaced which complicated the process of outlining the properties. Nevertheless, progress is being made. With a bit more work, a complete base map will be produced, to which information can be added at any time. When complete, the base map will enable the establishment of a GIS which, over time, will allow the compilation of natural resource information. This information will be useful in long-term monitoring and establishment of management plans for QUBS properties.

Parks Canada - Rideau Canal

In 1993, Parks Canada - Rideau Canal, via Canal Superintendent, Mr. Tom Kovacs, graciously provided QUBS with complimentary canal passes for both our pontoon boats. This generosity is greatly appreciated and facilitates our study of a variety of water bodies along the canal during research and teaching initiatives.

Open House

The Open House was held on July 11 in 1993. As usual, there was a great turnout from the area. In all, some 325 visitors toured the displays of current research topics. The effort that QUBS regulars put into this event ensures its success year after year. Thank you all for preparing quality displays and for presenting them with enthusiasm. Your efforts make for an enjoyable and stimulating tour.

The 1993 version of the Community Newsletter (thirteenth edition) was distributed in early July to 850 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 public relations efforts are important in maintaining close contact with the neighbouring community. It is most encouraging to witness the increasing involvement of the community in activities at the field station.

Friends of Opinicon

The "Friends of Opinicon" had a busy summer in 1993 under the able guidance of Naz MacDonald, with assistance from Floyd Connor, and even published their first newsletter. The group's season of activities extended from June through early September, with a total of about 10 events.

To quote Naz, from Newsletter #1,

"It was wonderful to see how well the weekly nature walks were attended; we rarely got fewer than twelve people. It was gratifying that so many people were so enthusiastic and that there were many property owners who offered their lands for some of our walks.

We tried to focus each of our walks (and one barge cruise with Frank) on a different aspect of nature. Amphibians were featured in the early part of the summer because they were so plentiful and vocal, and were replaced on our hikes by birds and bird song during the avian breeding season. Later through the summer we concentrated on the insects, wildflowers and trees because by this time the frogs were silent and the birds had finished their parenting chores and were starting to leave.

The turnout for the "Bat" lecture was a stunning success to say the least. Thanks to Dr. James Fullard for a spirited, informative evening. More talks like this on various subjects of general interest are being planned for next summer.

We were saddened by the death of Sonja Johnson, who was one of our first 'Friends' and a most enthusiastic supporter. We will miss her very much."

A real highlight of the 1993 Friends of Opinicon season, not mentioned by Naz in the newsletter, was the potluck supper (with major contributions by Naz) held at her log cabin home on Hughson Island in August. Along with superb food and setting, participants enjoyed plenty of animated conversation and opportunities to meet their neighbours. The consensus was that this was a very successful gathering.

As the summer drew to a close, the Friends enthusiastically received the news of the intended purchase of the "Back Lakes" property by the Biological Station. The Friends of Opinicon have agreed to assist in fundraising (target \$25,000) toward this acquisition. Many members of the Friends have already made contributions and pledges toward achieving this goal. Thank you, friends!

Hummertime

The Hummertime study of Ruby-throated Hummingbird migration and nesting chronology enjoyed its fourth summer at QUBS in 1993.

This study is co-ordinated by Kit Muma (QUBS researcher), Peggy Latimer (QUBS neighbour and friend), and Floyd Connor. Although not an official function of the Biological Station, it welcomes and benefits from the use of the Hewlett-Packard computers and station facilities during its semi-annual analysis, newsletter-writing and mailing, and planning meetings.

In 1993, the Hummertime network expanded to almost 300 participating households, with 90 of those returning completed data forms. In return for their involvement, participants received newsletters in March and again in November. Most of the cost of these mailings was covered by a grant from the Baillie Fund of Long Point Bird Observatory.

New contacts made by Peggy with people from Eastern Canada and the American South promise to lead to interesting results and improved geographic coverage and resolution of Ruby-throat migration patterns in 1994.

Seminars

In 1993, we did not have a long-running series of seminars. However, we were able to offer two major seminars which were very well-attended. The first was presented by Dr. Martin L. Cody (Department of Biology, UCLA) and titled, **Diversity Components in Australian Birds**. This seminar was held on May 6 in conjunction with Dr. Ratcliffe's Field Course on Bird Song and Dr. Harmsen's Field Course on Ecological Interactions. The second seminar was given by Dr. James Fullard

(Department of Biology, Erindale College of University of Toronto) and titled *Natural History of Ontario Bats*. This seminar featured some captured bats and Dr. Fullard's collection of bat slides. Delivered in his inimitable style, this seminar was a hit with regulars and our "Friends of Opinicon" who packed the conference room on the night of July 22.

Nature of Things

As part of a program on the status of neotropical migrants and forest habitat, a CBC film crew made several visits to the station in 1993. Carloyn Underwood and her film crew tried to get good footage of many of the songbirds in the vicinity of QUBS. Many of our regulars helped out with this work, notably Paul Martin, who spent quite a bit of time ushering the crew to good sites, nests and cooperative birds. The program aired on the March 1, 1994 episode of the "Nature of Things", hosted by David Suzuki. Although the field station was not directly featured, it is good to note that QUBS regulars had significant input to the production.

BBC Nature Series

Another film crew, this time from the BBC, also did filming in and around the field station in 1993. Producer Nigel Marvin and cameraman Mark Payne-Gill were preparing a segment of the "Nature" series on the role of plants and animals in forensic science. The film is tentatively called "The Natural History of Crime". At QUBS, the crew attempted to film a yellow warbler using hair from a skull during its nest-building. With other segments on wolves, maggots, packrats and alligators, the topic sounds pretty grisly but nevertheless fascinating. The program will probably air in Britain in February 1994 and appear in North America a few months later. Watch for it.

Station User Fees

Recognizing the impact of recession on funding and finances, QUBS fees for 1994 will be unchanged from 1993. Continuing low rates of inflation and high levels of use at the station should make a balanced budget possible in 1994. The fee schedule for 1994 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, Frank endeavoured to prepare an updated listing for inclusion in this report. Each major user was contacted and asked to review their individual list. These updated lists have been incorporated into the complete listing published as an appendix to this report.

Please continue to forward copies of theses (we will have them bound as necessary) and publications (or at least a citation of same) as they become available.

Acknowledgements

The continuing success of the field station depends on many things, but perhaps foremost among these in the industry and devotion displayed by our staff. Thank you to Floyd Connor (Assistant Manager), Rod Green (Maintenance Assistant), Jeff Cross (Cleaning Services), Marg Phelan (Food Service Coordinator), Karen Wetmore (Food Service Staff), Kevin O'Rourke (Food Service Staff) and to Mary Elaine Goulah, Jay Phelan and Ron Vinkle Jr. (Part-time Assistants).

Joan Curtis

We were shocked and saddened by the untimely death of Joan Curtis, neighbour and friend to QUBS, on January 29, 1994. We offer our sympathy to Joan's family, especially daughters Alison and Karen, sister Dorothy Haig and mother-in-law Elsie Mae Curtis. The Curtis farm passes to daughters Alison and Karen, for whom we hope it will continue to be an important centering point in their lives.

Congratulations

On April 24, 1993, Andrew John Weatherhead was born. Congratulations to parents Dr. Pat Weatherhead (Carleton University) and Karen Metz, two long-time station regulars.

In fall of 1993, Pat and Karen moved into their new house near Monaghan's on Lake Opinicon. It will be interesting to have the Weatherheads as permanent neighbours of QUBS.

The Weather Report

As part of QUBS Annual Reports, a sample of the kinds of weather data compiled and available at the field station is included. To obtain weather information, contact Floyd Connor at QUBS. In this report, air temperatures for April through July and water temperatures from ice-off through July are presented in graphical form.

Cover

The cover sketch of a Cerulean Warbler was done by Ken Otter. Thanks, Ken!

Table 1: Summary of course credits in the Ontario Universities Program in Field Biology earned at Queen's University Biological Station in 1993.

Module Topic	Professor & Affiliation	Date	Credit/ Student	Q	C	Y	B	Wn	Wo	To	Tr	G	O	M	Wt	Total Students/ Module	Total 1/2 Course Credits
Acoustic Communication - Birds	Ratcliffe (Q)	May 2 - 8	1/4	3		3	1		1			1		1		10	5
Ecological Interactions	Harrison (Q)	May 2 - 8	1/4		1	2	1	2	1	1	1	1	2	2		14	7
Behavioural Ecology - Birds	Briskie (Q)	May 9 - 22	1/2	5		1		1		1			1	2		11	11
Insect Taxonomy & Ecology	Gunderman (Mt)	Aug. 15 - 21	1/4	1		2		1		2	1	1		2		10	5
Systematics of Flowering Plants	Pringle (Mt)	Aug. 22 - 28	1/4	5		3				1	1			1		11	5.5
Evolutionary Ecology of Plants	Eckert (Q)	Aug 29-Sept 4	1/4	3		1	1		2		1	2		2		12	6
Limnology	Hall (Q)	Sept. 5 - 11	1/4	7					5			1		1		14	7
Total Number of Student - Weeks				29	1	13	3	5	9	6	4	6	4	13	0	93	-
Half - Course Equivalents				14.5	0.5	6.5	1.5	2.5	4.5	3	2	3	2	6.5	0	-	46.5

Q = Queen's
To = Toronto

C = Carleton
Tr = Trent

Y = York
G = Guelph

B = Brock
O = Ottawa

Wn = Western
M = McMaster

Wo = Waterloo
Wt = Windsor

Table 3: Overall summary of the Ontario Universities Program in Field Biology in 1993.

	Q	C	Y	B	Wn	Wo	To	Tr	G	O	M	Wt	Total Student - Weeks in Modules	Total Half-Course Credits
Total Student - Weeks Not at QUBS	73	44	32	23	66	48	109	22	82	21	45	16	581	290.5
Total Student - Weeks at QUBS	29	1	13	3	5	9	6	4	6	4	13	0	93	46.5
Total Student - Weeks in Field Modules	102	45	45	26	71	57	115	26	88	25	58	16	674	-
Total Half - Course Equivalents in Field Modules	51	22.5	22.5	13	35.5	28.5	57.5	13	44	12.5	29	8	-	337

13.8% of credits in entire program earned at QUBS in 1993

(19% in 1992; 14.1% in 1991; 16.3% in 1990; 29.2% in 1989; 15.6% in 1988)

28.4% of Queen's credits earned at QUBS in 1993

(33.6% in 1992; 15.8% in 1991; 24% in 1990; 51.4% in 1989; 22.5% in 1988)

Table 2: Summary of course credits in the Ontario Universities Program in Field Biology earned at locations other than QUBS in 1993.

Module Title	Professor & Affiliation	Date	Location	Credit/ Student	Q	C	Y	B	Wn	Wo	To	Tr	G	O	M	Wt	Total Student/ Modules	Total 1/2 Course Credits
Tropical Biology	Reef (G)	Apr-May	London	1/2	1								15				16	16
Desert Ecology	Hanfield (Wn)	May	Alvina	1/2	1	1			6	1	2				2		13	13
Behaviour of Migrating Birds	Nel & Risley (Tr)	May 2 - 15	Prince Edward Is.	1/2	3		1	1	2	1	1	2	1				12	12
Lake and Stream Ecology	Dickson (B)	May 9 - 15	Algonquin	1/4	3	1			1	3	1		1	1	1		12	6
Great Lakes Field Biology	Marchant (Wt)	May 9 - 22	Lake St. Clair	1/2	1	1			3		2	1	2		2	8	20	20
Scrubland Breeding Biology	Quinn (M)	May 16 - 29	McMaster	1/2	2			1			1			1	7		12	12
Field Ornithology	Rising & Pensen (Tr)	May 17 - 31	Repetto Island	1/2	1	1		1			19			1			23	23
Marine Developmental Biology	Blaas (C)	May 20-June 12	Huronian	1/2		6	1	2	1	1		2		2	1		16	16
Field Methods in Plant Ecology	Bursley (Y)	June 19-27	Marionville Island	1/4	1		8								1		10	5
Environmental Statistics	Gunn (Wn)	Aug 1 - 14	Huronian	1/2													0	0
Neural History	Lohr (Y)	Aug 15 - 21	Algonquin	1/4	2		4	1	2		1					2	12	6
Marine Biology	Sennel (Tr)	Aug 15 - 30	Huronian	1/2	2	1					10	1					14	14
Tropical Insect Biodiversity	Wood (C)	Aug 15-Sept 4	Cocoa River	1/2	2	2	1	1	1	1	1	1	2		1		12	12
Arctic Ecosystem	Svoboda (Tr)	Aug 16 - 28	Churchill	1/2	2	1				5							9	9
Alpine Ecology	Miller (Wn)	Aug 20-Sept 4	Kananaskis	1/2	5	1			6	1	2	1	1	1			18	18
Comparative Limnology of Ontario	Zimmerman (Tr)	Aug 21 - 28	Southern Ontario	1/4	5		1		1		3	1	1				12	6
Aquatic Microbiology and Ecology	Pick (O)	Aug 22 - 29	U. Memorial Budda	1/4			1						1	3			5	2.5
Experimental Marine Biology	Owen & Taylor (Wt)	Aug 27-Sept 12	Huronian	1/2	6		1	2	5	7	2		1	1			25	25
Boreal Landscape	Merritt (C)	Aug 28-Sept 5	Pelabuhan N. Pock	1/4	1	1	1			1	1	1	1	1	1		9	4.5
Terrestrial and Aquatic Biology	Hawdon (Wn)	Aug 28-Sept 10	Algonquin	1/2	1	2	1	1	3	4	2	1		1			16	16
Field Biology	Cameron (Y)	Aug 29-Sept 4	U. Memorial Budda	1/4	1		5			2	1						9	4.5
Field Ecology	Noble (O)	Late Aug	Algonquin	1/2		1		1	2		1		6	1			12	12
Marine Biology and Oceanography	Billingham (O)	Aug-Sept	Huronian	1/2	1			1			2		11				15	15
Myxology	Kendrick (Wn)	Sept 4 - 17	Algonquin	1/2	2	3	1			5	1	1					13	13
Tropical Ecology	Kelam (M)	Dec 26-Jan 10	Jamaica	1/2		1			2	1					6		10	10

Naturalists' Workshop 1993

In 1993, QUBS offered its fifteenth edition of the naturalists' workshop. The week-long workshop was held from May 22 through May 29, with an enrolment of 17. These participants represented a cross-section of people with interest in natural history and environmental topics (one teacher, three students, eight amateur naturalists, one staff from the Ontario Ministry of Natural Resources, two staff from Conservation Authorities, one staff from a nature centre and one environmental consultant). In 1993, special themes centred on Canadian shield habitats vs. limestone-based habitats, resource mapping and Geographical Information Systems.

The McCorquodale Scholarship was awarded to Len Batley, a part-time student (University of Waterloo) with a young family and strong interest in urban and regional planning and sustainable development. This scholarship adds a welcome extra dimension to the program, enabling attendance of someone who might not otherwise be able to attend because of financial constraints. Thank you to Shannon McCorquodale, a long-time friend of the station, whose continuing generosity provides the scholarship named after her.

The S.B. Rutherford scholarship was awarded to Royal Lee in 1993. Royal, now retired, has been an avid naturalist all of his life. This scholarship is named for S.B. Rutherford, a former biology teacher at Clarke High School in Orono, Ontario. The selection committee for this scholarship is headed by Roy Forrester, an alumnus of the naturalist workshop program, and chairman of the S.B. Rutherford Foundation.

This year's team of instructors was headed by Dr. Jim Pringle and Dr. Adele Crowder (Royal Botanical Gardens and Queen's - Biology, respectively). Thank you both for your continued involvement in the program. The workshop remains successful, in large part, because of the devotion of time and effort of all our instructors: Floyd Connor (QUBS), Dr. Francis Cook (National Museum of Natural Sciences), Dr. Chris Eckert (Queen's - Biology), Jennifer Harker (M.M. Dillon Consultants), Dr. James Fullard (Erindale College of U of T - Biology), Dr. Sandra McBride (Queen's - Geological Sciences), Mike Ogilvie (OMNR - Charleston Lake Provincial Park), Frank Phelan (QUBS), Dr. Bruce Smith (Ithaca College - Biology), Dr. Rollie Tinline (Queen's/IBM GIS Lab) and Gus Yaki (Nature Travel Service).

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

This year's workshop featured two excellent road trips. The first to Blue Mountain, south of Charleston Lake, an outcrop of shield rocks with rare species and a magnificent view. We were conducted to the site by Charleston Lake Provincial Park personnel. Many thanks to Mike Ogilvie for arranging this visit. The second trip took us to limestone plain sites and a tour of the Roblin Hell-Holes. Many thanks to Ron Storrington and family for permission of access and the guided tour.

Plans are taking shape for the 1994 edition of the workshop (May 21 to 28). Special topics will include bird communities in relation to forest habitat parameters, forest changes over time and old-growth forests.

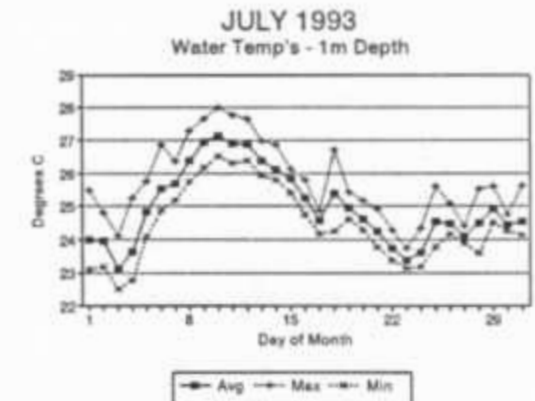
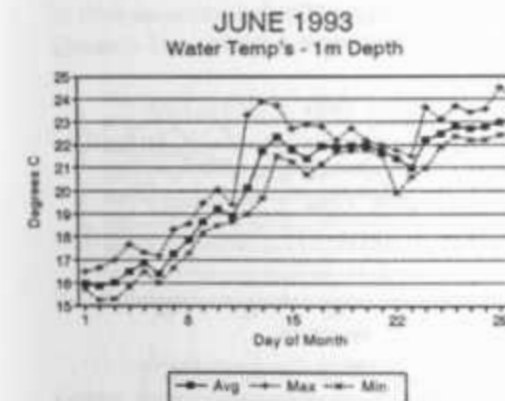
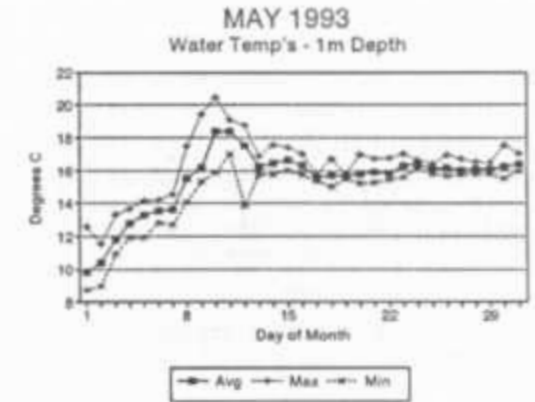
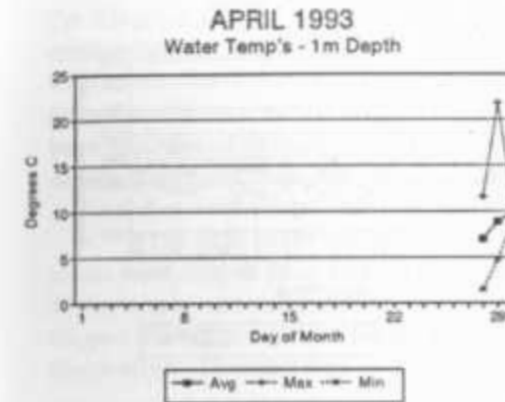
1993 Naturalist Workshop Participants

Carson Thompson
Yvette Bree
Royal Lee
Len Batley
Ted Rosen
Mary Guest
Rose-Marie Chretien
Lizanne Bacon
Jim Murphy
Nancy Eldblom
Marg Carruthers
Kathleen Fall
Catherine Gill
Anne Gill
Janet Sands
Bart Carswell
Dr. David Rutenberg

Rideau Valley Conservation Authority, Manotick, Ontario
Sandbanks Provincial Park, RR#1, Picton, Ontario
Amateur Naturalist, Orono, Ontario
Part-time student, University of Waterloo
Amateur Naturalist, Toronto, Ontario
Part-time student, Trent University, Peterborough, Ontario
Raisin Region Conservation Authority, Martintown, Ontario
Ojibway Nature Centre, Windsor, Ontario
Amateur Naturalist, Orleans, Ontario
Amateur Naturalist, Potsdam, New York
Amateur Naturalist, Toronto, Ontario
Amateur Naturalist, Toronto, Ontario
Student, St. Lawrence College, Kingston, Ontario
Amateur Naturalist, Lynden, Ontario
Amateur Naturalist, Toronto, Ontario
Part-time student and Consultant, Oshawa, Ontario
Professor, Queen's School of Business and Amateur Naturalist,
Kingston, Ontario

QUBS WEATHER 1993

Water temperatures of Lake Opinicon as measured electronically
every 10 seconds, at a depth of 1 meter



Note the relatively flat traces for the second half of May.
This may have had important effects on biological phenomena such
as the chronology of fish spawning and insect emergence.

Dr. Lonnie Aarssen

"Plant Ecology and Evolution"

Judie Venecz - "Response of purple loosestrife (*Lythrum salicaria*) to shoot apex removal" - M.Sc. Thesis

The lush purple flowers that peek out from roadside ditches and threaten our wetlands is not a stranger to the Kingston and South Crosby Township area. Since the 1980's, many studies have focussed on the control and eradication of *L. salicaria* by natural, biological and chemical means. None have been fully successful in the long term sense. Ducks Unlimited has suggested to their audiences (primarily cottagers) to either remove the entire plant from the soil or to cut off the flowering spikes. The effect of inflorescence removal on *Lythrum salicaria* has not been recorded or studied. We predict that the plant should branch upon removal of the apical meristem. Many experiments have shown that the increase in branching is often correlated with increase in biomass and fecundity.

The field study was carried out in Stumpy Bay at QUBS. Four treatments were performed: one group of plants were clipped three times at the beginning of the season; another group was clipped three times at the beginning of the season and subsequently when flowering (6 clippings total); another group had only their flowering spikes clipped during the season (about 4 - 5 times); the final group was left undisturbed. At the end of the season (September - October) data on these plants were collected as well as the plants (above ground) themselves.

Theses:

Murphy, S.D. 1993. The occurrence and consequences of heterospecific pollen transfer: Allelopathic pollen in *Phleum pratense* L. (Poaceae) and the *Hieracium* L. aggregate (Asteraceae). Ph.D. Thesis, Department of Biology, Queen's University, Kingston, Ontario.

McLernon, S. 1993. Heterospecific pollen transfer in sympatric grassland species. B.Sc. Thesis. Department of Biology, Queen's University, Kingston, Ontario.

Lundholm, J. 1993. Neighbour effects on gender variation in common ragweed. B.Sc. Thesis. Department of Biology, Queen's University, Kingston, Ontario.

Publications:

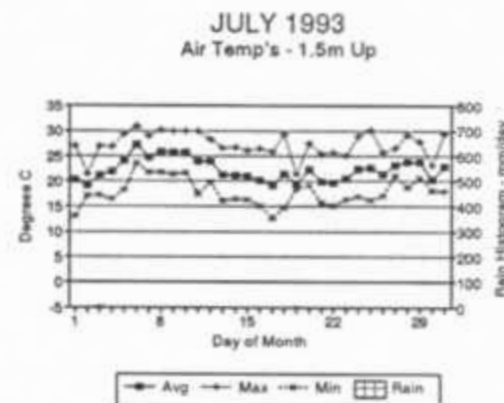
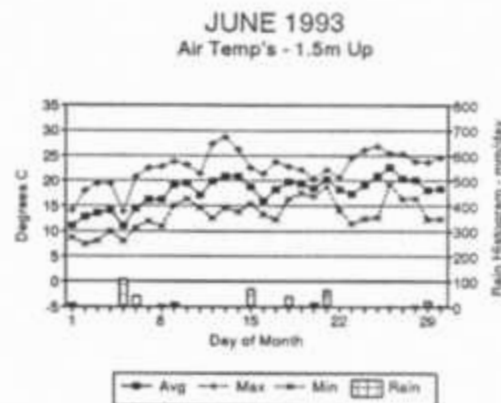
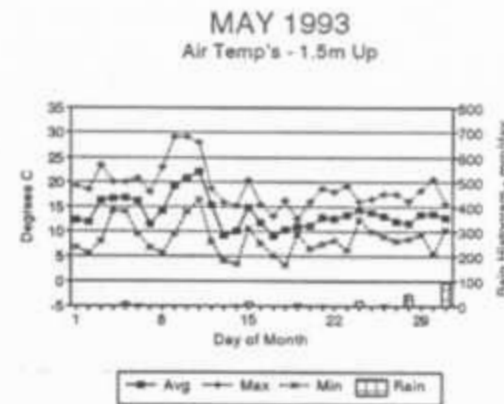
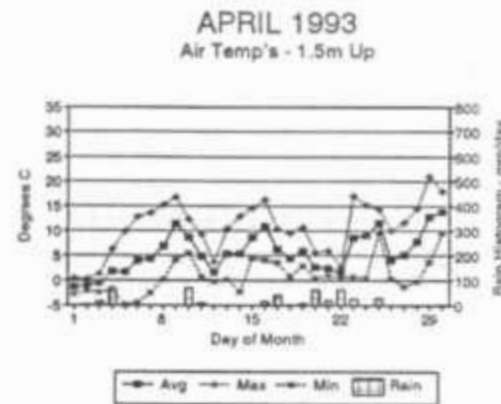
Vasseur, L., Aarssen, L. W. and T. Bennet. 1993. Allozymic variation in local apomictic populations of *Lemna minor* (Lemnaceae). Amer. J. Bot. 80:974-979.

Dr. James Briskie

"Sibling relatedness and the evolution of loud begging calls in nestling birds"

In 1993, we completed our study of begging behaviour of nestling birds. Begging is one of the most conspicuous behaviours of nestling birds and the traditional view is that it evolved as a way for nestlings to communicate nutritional requirements to their parents. However, a number of recent models suggest that the form and intensity of begging may also be adaptations to sibling competition. By comparing the loudness of begging calls across a variety of species, we are testing the hypothesis that louder begging has evolved in conjunction with reduced relatedness among the members of a brood (as determined by previous studies of DNA fingerprinting). That is, species in which siblings are only half-brothers or sisters (due to female promiscuity or brood parasitism) should be more selfish and beg louder than birds in nests where young are full siblings.

Air temperatures at Queen's weather tower (primary Y-axis),
and rainfall (secondary Y-axis)



The preceding two pages of graphic summaries are examples of the kinds of data available from the QUBS electronic weather monitoring system. The .prn files produced by the weather micrologger are importable to Lotus 123, and the resulting .wk1 files were used in Quattro Pro to produce the graphics. Other data recorded by the system, based on a 10-second sensor scan interval and a 20-minute final-memory summarization interval, include averages and extrema for surface and 3m water depths; soil temperatures, wind speed, relative humidity, and sky and solar radiation. Wind direction and rainfall are also monitored.

Assistants: Chris Naugler and Susan Leech

Dr. Christopher G. Eckert

"Plant Evolution & Population Genetics"

"The evolution of partial self-fertilization in *Decodon verticillatus* (Lythraceae)"

There is a burgeoning interest in the evolution of inbreeding since it greatly affects the fitness of both individuals and populations, as well as the distribution of genetic variation and hence the mode and tempo of evolution. Theoretical studies on the evolution of self-fertilization in flowering plants consistently predict only two stable endpoints of mating-system evolution: predominant selfing with little or no inbreeding depression and predominant outcrossing with strong inbreeding depression. My studies on the tristylous wetland perennial, *Decodon verticillatus* (Lythraceae) present a challenge to this theory. First, *Decodon* practices intermediate levels of self-fertilization; estimates of the selfing rate based on allozyme variation in 10 populations (including 6 from QUBS) are consistently around 30%. Second, glasshouse experiments and population genetic analyses as well as long-term field experiments conducted in wetlands on the 'new land' at QUBS revealed that, despite substantial selfing, inbreeding depression in *Decodon* is very strong. The transmission advantage of selfing is more than outweighed by reductions in the fitness of selfed offspring, suggesting that the persistence of partial selfing depends on more than just the evolutionary balance between the cost of meiosis and inbreeding depression.

This summer, I initiated a new study to test the hypothesis that partial selfing observed in northern populations of *Decodon* is a non-adaptive consequence of a post-glacial change in pollinator fauna to which populations of this long-lived clonal species have yet to adapt. Preliminary data indicate a significant difference in the species composition of pollinators between northern (Ontario & Michigan) and southern (Georgia & Florida) populations. The former are visited by bees, whereas a substantial component of the southern visitor fauna is made up of butterflies, which are thought to affect less self-pollination than bees. *Decodon*'s floral morphology lends some support for this hypothesis since it is more typical of butterfly- than bee-pollinated plants. Hence, northern populations may not presently attract the type of pollinator service under which floral morphology evolved. This hypothesis will be further evaluated by experimentally comparing patterns of pollen transfer and self-fertilization in northern glaciated populations with unglaciated southern populations.

Chris Eckert, Domenica Manicacci (CNRS, France) & Spencer Barrett (Univ. 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 five 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 work is also aimed at contrasting the population dynamics of this aggressive colonizer in its native and adventive ranges.

Katherine Mavraganis - "Floral morphology in dimorphic populations of tristylous *Decodon verticillatus*: Use it or move it" - B.Sc. Thesis.

The exquisite morphology of many insect-pollinated flowers is thought to be the product of strong selection on efficient pollen donation and receipt. Tristylous, a particularly complex sexual polymorphism, is widely used as a textbook example of this: The precise reciprocal positioning of anthers and stigmas among the three floral morphs appears to have evolved to promote efficient cross-pollination. In tristylous *Decodon verticillatus*, however, more than a third of 163 populations surveyed lack one of the three floral morphs. We would expect natural selection to favour repositioning of the particular anthers which would donate pollen to 'the lost morph'. This hypothesis is being tested by comparing the floral morphology of dimorphic and trimorphic populations. Floral structure is being

quantified using computer-based image analysis on samples from populations across the species range, with a particular focus on the populations around QUBS.

Publications:

Eckert, C.G. and S.C.H. Barrett. 1994 Inbreeding depression in partially self-fertilizing *Decodon verticillatus* (Lythraceae): experimental and population genetic approaches. *Evolution*, in press.

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

Eckert, C.G. and S.C.H. Barrett. 1994. Floral variation, self-compatibility and tristylous in *Decodon verticillatus* (L.) Ell. (Lythraceae). *Biological Journal of the Linnean Society*, in press.

Eckert, C.G. and S.C.H. Barrett. 1993. The inheritance of tristylous in *Decodon verticillatus*. *Heredity*, in press.

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

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

Drs. Dolf Harmsen and Adele Crowder

"Patterns of succession in old field communities"

This is a long term project initiated in 1975. Earlier intense periods of research produced a number of publications on the early, rapid change stages of old field succession, and a few further publications are in preparation. The rate of change is much slower, since the late 1980's, and in 1992 and 1993 no experimental work was conducted.

However, the project will be revitalized as Drs. Crowder and Harmsen have received funding to conduct specific experiments and surveys related to the current successional stage of the field. In 1994 and 95 the transition from field to shrub-tree stage will be studied. Especially seed dispersal, establishment and early survival of tree seedlings will be studied.

Dr. Laurene Ratcliffe

"Acoustic communication and Mate Choice in Birds"

Field work in 1993 focused on continuing studies of sexually-selected signalling behaviour in black-capped chickadees. Significant effort was devoted to a second season's measuring of levels of extra-pair paternity in relation to male winter dominance rank and spring singing behaviour. We also ran a successful pilot experiment testing Macintosh software for interactive playback.

Zanette, L. and L.M. Ratcliffe. Social rank influences conspicuous behaviour of Black-capped Chickadees (*Parus atricapillus*). *Animal Behaviour* (accepted June 29, 1993).

Sharman, M.Y., Robertson, R.J., and L. Ratcliffe. Vocal repertoire of the Tree Swallow (*Tachycineta bicolor*): a structural and contextual analysis. *Amer. Midl. Nat.* (accepted January 1994).

Shackleton, S.A. and L. Ratcliffe. Matched counter-singing signals escalation of aggression in black-capped chickadees. *Ethology* (accepted January 1994).

"Extra-pair Paternity in the Black-capped Chickadee in Relation to Dominance Rank." - Ken Otter, Laurene Ratcliffe and Peter Boag.

Black-capped chickadees are among the few species of birds in which females are known to instigate and actively seek extra-pair copulations, and thus present an optimal species in which to study female mixed reproductive strategies. During the winter and spring of 1993, we assessed the dominance rank of 75 banded birds at 3 winter feeding sites and collected blood samples nestlings, adults, and neighbouring males of 8 nests. We are currently using DNA fingerprint analysis to assess the paternity of these nests, which will be added to the ongoing analysis of extra-pair paternity in the population, begun in 1992. Results from the 1992 season show that 3 of the 8 nests sampled had extra-pair young (37% of nests) and 19% of nestlings were genetically mismatched from their putative father. All extra-pair nestlings were fathered by neighbouring males that ranked higher in dominance to the female's mate. With the addition of 8 more nests, we will assess the repeatability of extra-pair paternity between years and increase the sample size to conclusively determine whether female black-capped chickadees adopt a mixed reproductive strategy of social monogamy while seeking extra-pair copulations from higher ranked males. This study is the basis of an ongoing study of female reproductive strategies in chickadees that will investigate which male characteristics influence mating decisions of females, and what benefit may be gained by some females in the population adopting mixed mating strategies.

Publications:

Otter K, L. Ratcliffe, & PT Boag. 1994. Extra-pair paternity in the Black-capped Chickadee. *Condor* 96:218-222.

Assistants: Sarah Rice, James Fotheringham, Linda Webster, Paul Martin, Susan Leech

Ken Otter - "Intersexual Selection and Song in the Black-capped Chickadee" - MSc Thesis

Song in chickadees is known to function in territorial defence, and thus act as an intrasexual signal. Using mate removal experiments at the Queen's University Biological Station, I found evidence that the intense singing at dawn in this species also acts as an intersexual signal. Males appear to direct their dawn chorus at their mate, potentially to stimulate the female to copulate rather than seeking extra-pair copulations elsewhere. Removal of the female causes the male to increase song output and increase movement throughout the territory. The function of increased song output and movement may be an attempt by the male to re-establish contact with the missing mate, or to attract a replacement female in her absence.

I then tested the responses of estradiol treated female chickadees to broadcast of male song in the laboratory at Queen's University. Although responsiveness to estradiol implantation was variable, females gave a greater number of copulation displays, and display for greater duration, in response to conspecific song over heterospecific song. Females also responded less to song with abnormally high internote frequency ratio (Altered Ratio) and decreased within-note frequency ratios (Altered Glissando). Females made no distinction between song with increased song rate or increased degree of absolute frequency shifts. Female preferences for songs that maintain species characteristic frequency ratios may transfer to mate choice in wild individuals and select against deviant song in the population.

Publications:

Otter K & L. Ratcliffe. 1993. Changes in the singing behaviour of male black-capped chickadees, *Parus atricapillus*, following female removal. *Behavioral Ecology and Sociobiology* 33:409-414.

Assistants: James Fotheringham, Linda Webster, Paul Martin, Susan Leech

Ken Otter, Milan Njegovan, Chris Naugler, James Fotheringham and Laurene Ratcliffe. - "Interactive Playback Techniques in Frequency Matching Experiments With Black-Capped Chickadees"

Black-capped Chickadees are a single repertoire species with a simple, two-note, tonal song, *fee bee*. However, individual males are able to shift the absolute frequency of their song up and down within a species typical frequency range, and may use this flexibility in the frequency of song in order to frequency match neighbouring males during territorial disputes. Males that frequency match are more likely to escalate conflicts than non-matching males, thus suggesting a function to frequency matching in signalling intent. In order to test song matching in other species, researchers have used customized computer equipment for song playback production. During the 1993 field season, we conducted a pilot study in interactive frequency matching, using a novel playback apparatus. Using stimuli stored as individual stacks in HyperCard software, we used a laptop Macintosh Powerbook to generate the interactive playback stimuli. This technique has advantages over the currently available interactive playback apparatus due to its more compact size, greater ease of operation, and the greater availability of the equipment for most researchers. The system offers an alternative technique for simple interactive playback experiments.

Publications:

Otter K, M Njegovan, C Naugler, J Fotheringham, & L Ratcliffe. Accepted January 1994. A simple method of interactive playback using a Macintosh Powerbook Computer. *Bioacoustics*.

Ken Otter - "The Impact of Potential Predation on the Foraging Behaviour of Eastern Chipmunks"

Predation risk may have a profound impact upon foraging behaviour. I studied how potential exposure to predation affected the foraging behaviour of eastern chipmunks. I measured the time taken to approach a patch (Approach Time), residency in the patch (Patch Residence), amount of Vigilance and Load Size of seeds taken by chipmunks foraging at patches (food trays) in both open and forested sites.

Chipmunks have lower Approach Times to trays in the open than to trays amongst forest cover. Although the Load Size taken did not differ between the two sites, chipmunks had increased Patch Residence in open patches versus cover patches, as a result of increased Vigilance. As Load Size did not increase with Patch Residence in the open patches, foraging in the open occurs at a lower gain rate than foraging in closed habitats. Chipmunks may require both patch types in order to maximize their cache of seeds for over-winter survival. As increased vigilance while foraging in open sites may decrease risk of predation and allow chipmunks to utilize these patches, the loss in gain rate while foraging in open patches may be offset by the ability to use exposed patches to increase long-term survival.

Sarah Rice - "The effect of supplementary feeding on the singing behaviour and breeding success of male black-capped chickadees" - BScH Thesis

My study was designed to determine if song output was an indicator of the energetic condition of male black-capped chickadees (*Parus atricapillus*). In May 1993, I placed feeding trays in six breeding territories of colour-banded male black-capped chickadees at the Queen's Biological Station, Lake Opinicon, Ontario, during the pre-incubation period, the singing behaviour of 12 males were supplementary fed, and six were not. These males were then subjected to playback experiments of conspecific song broadcast from the centre of their territory. Their vocal response to playback was recorded. In collaboration with Ken Otter, we collected blood samples from parents and chicks of the studied birds and from the males in neighbouring territories, to examine extra-pair paternity in fed

and unfed birds. Preliminary analysis indicates there was no significant difference in song rate or length of the dawn chorus between fed and unfed birds. These results indicate that the dawn chorus is not energy-limited. Response to playback was also similar. Results do show that fed birds always sang at higher rates suggesting a need for further work.

Assistants: James Fotheringham, Paul Martin, Ken Otter

James Fotheringham - "A test of the acoustic adaptation hypothesis using songs from common oscines" - (pre MSc pilot project)

Several studies have attempted to determine structural adaptations of bird song that correlate with native habitat. These studies have tested the acoustic adaptation hypothesis: that temporal and frequency properties of bird song have evolved to minimize sound degradation and maximize transmission range in native habitat. I constructed a playback tape from field recordings taken at QUBS between 24 April and 2 June to be used in song transmission experiments. At least two songs from three individuals from 36 common species were recorded from <10 m. All songs were broadcast in an open field (Bridget's grid), a dense deciduous forest (Skycroft property) and a marsh (Cow Island). I recorded the songs in each habitat at 5, 10, 25, 50, 75, and 100m from the speaker. In sum, two songs from three individuals from each of 36 species were broadcast and recorded from six distances in open, forested and marsh habitat. Data from sound analysis of frequency and temporal characteristics of transmitted songs may be used to comparatively test the acoustic adaptation hypothesis.

Thesis

Fotheringham, J. 1993. Analysis of signal degradation in transmission of Black-capped Chickadee song and response of males to the playback of "near" and "far" conspecific song. B.Sc. thesis, Department of Biology, Queen's University, Kingston, Ontario.

Dr. Raleigh J. Robertson

"Evolution of Breeding and Parenting Strategies in Birds"

The focus of studies in 1993 was again on the role of extra-pair paternity in mating systems and evolution of paternal care in birds. Colleen Barber continued to examine rates of extra-pair paternity (EPP) in Tree Swallows, comparing EPP rates in a natural habitat (Portland Marsh) with the grids of nest boxes, and seeking correlates of EPP. Beth MacDougall did temporary removals of male Eastern Bluebirds to determine the efficacy of mate guarding as a paternity assurance strategy. Kelvin Conrad, returning as a post-doc, began a study of EPP in Eastern Phoebe. Mark Hovorka, as a field assistant and honours thesis student, conducted a study of fluctuating asymmetry in nestling growth in Tree Swallows in the Northeast Sanctuary. Greg Varty, for his honours thesis, documented the seasonal pattern of testosterone in male Tree Swallows, using the grid at Crystal Spring Farm. Laurie Martinovic assisted Colleen on the Tree Swallows. Finally, Laurie Stewart spent time at QUBS writing up a manuscript from her honours thesis.

"Structure of Forest Bird Communities and the Songbird Monitoring Project"

Paul Martin continued his studies of Least Flycatcher - American Redstart interactions. In conjunction with the Eastern Ontario Model Forest program, Paul also initiated a study examining the relationship of forest management practices to the songbird community. This study stimulated the hosting of the "Songbird Monitoring Workshop", and visits by EOMF personnel and tours.

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

My study examines the adaptive significance of a mixed reproductive strategy for female and male tree

swallows (*Tachycineta bicolor*). Past work on this population has shown levels of extra-pair paternity EPP that far surpass those in other socially monogamous passerines. In 1990, EPP occurred in 50% of the broods, with extra-pair males fathering 38% of the young (Lifjeld et al. 1993). The frequency of EPP increased to 90% in 1991 (P. Dunn and R. Robertson, pers. comm.). There was no evidence of intraspecific brood parasitism in the study population (Lifjeld et al. 1993).

A main objective of my study is to determine why the extent of EPP varies so much both among broods and years by identifying the net benefits of extra-pair copulations (EPCs) in this species. The most likely benefit is that of "good genes" where a female's fitness is increased by mating with males that have "superior" genes (Westneat et al. 1990). These good genes give the offspring increased viability or make them more attractive to the opposite sex. The good genes hypothesis, which I am testing, predicts that females mated to superior males will be monogamous, while those mated to inferior males will engage in EPCs with superior males. Both single and multiple paternity broods would occur in a population, with the multiple paternity broods consisting of a high proportion of extra-pair young (EPY).

To determine which variables account for the presence and absence of EPP in tree swallows (variables that act as a cue of quality), I am examining male and female morphological and behavioural features. Since mate quality may also vary with nest settlement date, territory quality and seasonal progression, I removed eleven early-settling males to allow later-settling males to settle and pair with the original female. The predictions that I am testing include: males and females with one or a combination of the following morphological features should be of superior quality: greater mass, symmetry, age, iridescence, and lower parasite loads. Males with these features or with higher song rates, or feather-collecting abilities should have little or no EPP in their nests and also father more young in other nests. A replacement male should have a higher proportion of EPP in his nest than would an original early-arriving male. Blood samples were taken from entire families to assess EPP frequencies through DNA fingerprinting.

A final objective is to compare EPP frequencies in natural cavities with those in nest boxes. Preliminary results indicate that EPP is common in natural cavities and is therefore not an artifact of the nest boxes. Rather, it appears to be an important component of the mixed reproductive strategy of tree swallows.

Mark Hovorka, Laurie Martinovic, Heather Ferguson, Tedd Robertson and Luis Pascual were dedicated and amazing field assistants. Financial support is provided by an NSERC grant to RJR, and a North American Bluebird Society award to CAB. DNA fingerprinting is performed in the Queen's University Molecular Ecology Lab, under the supervision of Dr. Peter T. Boag.

Beth MacDougall - "Is mate guarding really an effective paternity guard? An experimental study using eastern bluebirds." - M.Sc. Thesis.

I investigated the relationships between mate guarding, paternity and paternal care in the eastern bluebird, *Sialia sialis*. To test the effectiveness of mate guarding in defending paternity, I manipulated guarding by temporarily removing males during egg-laying. Preliminary results indicate that guarding and nonguarding males suffer similar losses of paternity to extra-pair males, as assessed by DNA fingerprinting. Females may exercise mate choice despite male attempts to control their mating decisions. Males that are prevented from guarding do not differ from control males in feeding rates to young, nor is there a difference in rates of fledging or growth between young in either treatment. In several cases, experimental males were replaced by other males. Replacement males may adopt young because they have some confidence of paternity in the brood.

This study was supported by an NSERC operating grant to RJR, and a North American Bluebird Society award to BAM. Fingerprinting was performed at the Queen's University Molecular Ecology Lab, under the supervision of Dr. Peter Boag.

Dr. Kelvin Conrad - "Tradeoffs of mating effort, paternal effort and certainty of paternity in eastern phoebes (*Sayornis phoebe*)"

I conducted a preliminary study to assess the trade-offs by male eastern phoebes between parental effort and mate guarding. Eastern phoebes are double-brooded and, in order to raise two broods in a single season, males must provide a large portion of post-fledging care to the young of the first brood. Does the parental effort males devote to care of first broods reduce their confidence of paternity in second broods? I planned to reduce or enlarge first broods and monitor extra-pair paternity in second broods using DNA fingerprinting. However, in my preliminary study, I found that analysis of parentage by the usual techniques was not feasible. The manipulative study cannot be conducted until more suitable DNA techniques are found. Competent and enthusiastic field assistance was provided by R. J. Robertson. DNA Fingerprinting is being performed in the Queen's University Molecular Ecology Lab and financial support is provided by an NSERC grant to RJR.

Mark Hovorka - "Fluctuating asymmetry and tree swallow (*Tachycineta bicolor*) nestling growth." - BScH thesis.

This study tested one of the fundamental assumptions of asymmetry theory: does environmental stress imposed during development increase levels of fluctuating asymmetry? This assumption was tested experimentally under field conditions through protein deprivation and brood manipulations; measurements of left and right ninth primaries, outer retrices, tarsi, and mass were obtained on days eight, twelve, and sixteen for all nestlings. Preliminary analyses have shown a significant reduction in the growth rates of all four characters for deprived nestlings. Interestingly, there is no significant difference in levels of fluctuating asymmetry between control and experimental nestlings. Further analyses will investigate the effects of measurement error upon the various characters and assess the contributions of directional asymmetry and antisymmetry to estimates of fluctuating asymmetry. This study was supported by an NSERC grant to Dr. Raleigh J. Robertson.

Paul Martin - "Competitive Interactions between the Least Flycatcher, *Empidonax minimus* and the American Redstart, *Setophaga ruticilla*" - BSc thesis.

Competitive interactions between these two species have been documented from New Hampshire, suggesting the Least Flycatcher to be the dominant competitor, often excluding adult (>1 yr. old) American Redstarts from their territories. This work examined different habitat parameters governing habitat use in these two species. In addition, high interspecific aggression by Least Flycatchers towards American Redstarts was documented using playbacks to attract the latter into the center of flycatcher territories. Even more interesting were playback experiments done on Least Flycatchers to test their ability to recognize interspecific (and interfamilial) song while testing their response to the song of American Redstarts. Preliminary comparative work on foraging behaviour and diet of the two species was also accomplished.

"Effects of Forest Management on the Forest Songbird Community"

This preliminary study provided habitat and landscape parameters governing habitat use by several key songbird species inhabiting mature hardwood forest in southeastern Ontario. Further examination of conifer plantations as well as avian predator and brood parasite habitat use were examined. All work will serve to direct further research on the effects of forest management on songbird communities of hardwood forests, as well as offshoot topics including the suitability of replanted forest (e.g. conifer plantations) for songbird communities. An additional annotated list of the birds that breed or are suspected of breeding within a 50 km area including Lake Opinicon was compiled, including a description of habitats used and population estimates (# pairs) within the defined area. This study was funded by the Eastern Ontario Model Forest program.

Jessie Deslauriers - I: "Phoebe Response to Cowbirds at the Nest"

Presentations of models of female Brown-headed Cowbirds and Song Sparrow controls were made at several nests of Eastern Phoebes, in a continuing project of testing the degree of male and female aggression toward female cowbirds near a nest at the incubation stage. Models were presented with and without tapes recordings of cowbird and song sparrow songs. The project is intended to test if Eastern Phoebes have learned to recognize female cowbirds as a possible threat.

II: "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 along with the time of day and temperature at 1 metre height for 23 sequences. The project involves testing the hypothesis that if a male is advertising his quality as a mate, he should sing most in the early morning when temperatures are cooler. If he sings when sound carries best, he should sing more often in early morning regardless of temperature. QUBS normally has a large resident population of Least Flycatchers. However, this summer, they appeared to bypass QUBS completely. Hopefully, they will return in the spring of 1994. Seven sequences were recorded on the Lindsay Lake Road.

III: "Temporal Movements of Spring Migrants"

Once again, mist nets were set along the hydro line to check for differences in temporal movement during spring migration of selected passerine groups and Parulid species in a geographic location which does not serve as a "funnel" for migration. The project is intended to compare such movements with those studied at Prince Edward Point.

Publications:

Conrad, K.F. and R.J. ROBERTSON. 1993. Patterns of parental provisioning by Eastern Phoebes. *Condor* 95: 57-62.

Lifjeld, J.T., P.O. Dunn, R.J. ROBERTSON and P.T. Boag. 1993. Extra-pair paternity in monogamous tree swallows. *Animal Behaviour* 45: 213-229.

Dunn, P.O. and R.J. ROBERTSON. 1993. Extra-pair paternity in polygynous tree swallows. *Animal Behaviour* 45: 231-239.

Venier, L.A., P.O. Dunn, J.T. Lifjeld and R.J. ROBERTSON. 1993. Behavioural patterns of extra-pair copulation in tree swallows. *Animal Behaviour* 45: 412-415.

Whittingham, L.A., P.O. Dunn and R.J. ROBERTSON. 1993. Confidence of paternity and male parental care: an experimental study in Tree Swallows. *Animal Behaviour* 46: 139-

Whittingham, L.A. and R.J. ROBERTSON. 1993. Nestling hunger and parental care in Red-winged Blackbirds. *Auk* 110: 240-246.

Rendell, W.B. and R.J. ROBERTSON. 1993. Cavity size, clutch size and the breeding ecology of Tree Swallows, *Tachycineta bicolor*. *Ibis* 135: 305-310.

Mitchell, J.S. and R.J. ROBERTSON. 1993. Tree Swallows cannot be classified as determinate or indeterminate layers. *Condor* 95: 546-553.

Conrad, K.F. and R.J. ROBERTSON. 1993. Clutch size in eastern phoebes (*Sayornis phoebe*). I: The cost of nest building. *Canadian Journal of Zoology* 71: 1003-1007.

Conrad, K.F. and R.J. ROBERTSON. 1993. Clutch size in eastern phoebes (*Sayornis phoebe*) II: age effects and seasonal variation. *Canadian Journal of Zoology* 71: 1738-1742.

Conrad, K.F. and R.J. ROBERTSON. 1993. Brood size and the cost of provisioning nestlings: interpreting Lack's hypothesis. *Oecologia* 96: 290-292.

Dunn, P.O., L.A. Whittingham, J.T. Lifjeld, R.J. ROBERTSON and B.T. Boag. In press. Effects of breeding density, synchrony and experience on extra-pair paternity in Tree Swallows. *Behavioural Ecology* (accepted 23 September 1992).

Meek, S.B. and R.J. ROBERTSON. In press. Interspecific competition for nestboxes affects mate guarding intensity in eastern bluebirds (*Sialia sialis*). *Animal Behaviour* (accepted 18 November 1992).

Rendell, W.B. and R.J. ROBERTSON. In press. Cavity-entrance orientation and nest-site use by secondary cavity nesting birds. *Journal of Field Ornithology* (accepted 2 March 1993).

Conrad, K. F. and Robertson, R. J. (1993) Relationship of age and sex to size and colour of Eastern Phoebes (*Sayornis phoebe*). *Wilson Bulletin* 105: 597-603.

Whittingham, L.A. and R.J. ROBERTSON. In press. Food availability, male parental care and mating success in Red-winged Blackbirds. *Journal of Animal Ecology* (accepted April 1993).

Meek, S.B., R.J. ROBERTSON and P.T. Boag. In press. Extra-pair paternity and intraspecific brood parasitism in eastern bluebirds, revealed by DNA fingerprinting. *Auk* (accepted 24 June 1993).

Meek, S.B. and R.J. ROBERTSON. In press. Effects of male removal on the behaviour and reproductive success of female Eastern Bluebirds *Sialia sialis*. *Ibis*. (accepted August 1993).

Dr. Raleigh J. Robertson and Dr. Katherine Wynne-Edwards

Greg Varty - "Testosterone Levels in Breeding Male Tree Swallows, *Tachycineta bicolor*" - BScH thesis

The purpose of this study was to provide a seasonal profile of testosterone levels in breeding male tree swallows. Tree swallows have been found to employ a mixed reproductive strategy. Previous studies at the Queen's Biology Station have found that extra-pair paternity (EPP) accounts for > 50% of broods and 38% of offspring (Lifjeld and Robertson 1992). What is not clear is which males are involved in extra-pair copulation (EPC), and if all males employ the same reproductive strategy or if there is individual variation amongst males. The seasonal profile of testosterone levels demonstrated a full phase shift, with testosterone levels remaining high one nesting stage longer, than would be predicted for a monogamous mating system. If high testosterone levels are a good indicator of a male's willingness to pursue EPC's then potentially this type of study could lend insight into the reproductive strategy of male tree swallows. At the very least this study reveals a potential relationship between EPP and high testosterone levels. This study was supported by an NSERC grant to Dr. Raleigh J. Robertson.

Dr. John Smol

Michael D. Agbeti - "Internal (autogenic) and external (allogenic) control of plankton succession in two lakes with different morphology but similar water chemistry" - Ph. D. thesis.

This was the final year of a long-term intensive research program designed to determine the effects of internal (autogenic) factors and external (allogenic) factors (in this case wind-induced polymixis) on the seasonal succession of phytoplankton and species composition. Sampling began in February 1989 and continued through 1993.

The study lakes were Lake Opinicon (shallow and polymictic throughout the ice-free periods) and nearby Upper Rock Lake (deep and dimictic). The lakes were sampled twice monthly during the ice-free seasons and once monthly during the winter (ice-covered season) and analysed for phytoplankton, zooplankton and water chemistry. The zooplankton were counted by Christine Watters. In addition, profiles of oxygen, temperature and conductivity, as well as Secchi depth measurements were recorded in the field. Detailed water chemistry analyses were also undertaken. Physical limnological variables were monitored using current meters. Records of air temperature, wind speed and solar radiation were supplied by QUBS.

The vertical distribution of phytoplankton during ice-cover was also examined in the two lakes. Sediment traps were deployed to monitor the following: (i) Chrysophyte population dynamics and encystment in natural populations; (ii) the long- and short-term preservation of phytoplankton in lake sediments; (iii) comparison of sediment accumulation (production and resuspension) in a polymictic and a dimictic lake; and (vi) the applicability of sediment traps in biomonitoring.

Thesis:

Agbeti, M.D. 1993. Comparison of Seasonal Succession of Phytoplankton in Two Lakes with Different Mixing Regimes. Ph.D. Thesis, Department of Biology, Queen's University, Kingston, Ontario.

Assistants: Members of Smol Lab (PEARL).

Dr. Bruce Tufts

"Physiology of Catch-and-Release Angling on Bass"

Again this year, we have been collaborating with Frank Phelan and Dave Philipp in an investigation of the stresses associated with catch and release angling in smallmouth and largemouth bass. This past summer, we focussed on the physiological stresses imposed on fish by transport in livewells at angling tournaments. It is known that not all fish survive after lengthy transport in live wells, but the physiological mechanism behind these mortalities has not been well-described. Brian Bagatto therefore took muscle and blood samples from bass at the Big Rideau Lake tournament to determine the physiological mechanism behind live well stress. In addition, parallel experiments were carried out on rock bass and perch under simulated live well conditions in the lab. Analyses of these samples are currently under way and should provide more insight into the physiological stresses experienced by fish in live wells.

Assistants: Jim Kieffer, Brian Bagatto.

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

Dr. R.L. Baker - Department of Zoology, Erindale College of University of Toronto, Mississauga, Ontario

"Antipredator versus antiparasite behaviour in larval damselflies"

Larval damselflies reduce their activity when fish predators are nearby; in particular, they greatly reduce their "grooming" behaviour. In contrast, when larvae of parasitic mites are present, larval damselflies are far more active and spend a great deal of time grooming themselves in what appears to be an obvious attempt to rid themselves of parasites. Dr. Bruce Smith (Ithaca College) and I are investigating the impact of these conflicting demands on both predation rates and levels of infestation of damselflies under field conditions.

Shelley Ball - "Costs of antipredator behaviour of larval Chironomids" - M.Sc. Thesis

Larval chironomids reduce their foraging behaviour when fish predators are nearby and, when reared in the presence of fish predators, emerge at a smaller body size than when reared without fish. This change in body size of prey is often interpreted as the "cost" of antipredator behaviour. However, risky environments may also result in smaller body size of prey if prey "decide" to escape the risky habitat by emerging sooner and at a smaller body size. This work is designed to disentangle the effects of lost foraging opportunities and facultative changes in life history on body size of prey.

Assistants: Hala Ali

Dr. Marcia Bjornerud - Department of Geology, Miami University, Oxford, Ohio

Keith Fowle - "Structural studies along the Perth Road shear zone, Frontenac Terrane, Southern Ontario" - M.Sc. Thesis

This study focuses on an ancient deep-crust fault zone exposed near the Queen's University Biological Station, along the former Canadian National railway line between Perth Road and Chaffey's Lock, Ontario. This zone, known as the Perth Road shear zone, is one of the prominent northeast-striking ductile fault zones that occur in high grade meta-sedimentary and meta-igneous rocks in the southeast part of the Grenville Province, a billion year old mountain belt, now deeply eroded, that may have rivaled the modern Himalayas in height.

Detailed field and microstructural studies of rocks exposed along the Perth Road shear zone reveal significant spatial and temporal complexity in the deformation history of the zone. Kinematic indicators (outcrop to microscopic-scale structures that indicate the sense of displacement) show that the direction of shear along the shear zone was non-uniform in space and time. Compositional differences partly govern the heterogeneity of deformation. Local lenses of marble contain dismembered tectonic inclusions of quartzofeldspathic ultramylonite and suggest that weak marbles accommodated extreme shear strains. Large strain gradients within all rock types suggest that strain softening behaviour was also important in localizing deformation during most of the period when the zone was active. However, superimposed features recording brittle and quasi-brittle behaviour suggest that the rocks either become strain hardened and/or were uplifted through the brittle-plastic transition late in the deformation.

Radiometric dating techniques using the mineral zircon from intrusive rocks that were emplaced during and after the formation of the Perth Road shear zone provide unusually good constraints on the timing of deformation along the zone. The Perth Road monzonite, dated at 1163 ± 3 Ma (Marcantonio *et al.*, Chem. Geol., 1990) is locally foliated, attributed to the shear zone, while a swarm of diabase dikes which cut the shear zone were dated at 1160 Ma are not (A. Davidson, 1993, pers. comm.). One contribution of this study will be to establish the physical condition of the Perth Road monzonite (magmatic, submagmatic, solid) at the time of deformation.

This study, like others on the Grenville shear zones, provide glimpses into the geometry and mechanisms of deformation in the deep crust during great mountain building events.

Assistant: Chris Simpson

Publication:

Fowlow, K. and M. Bjornerud. in review. Structural studies along the Perth Road shear zone, Frontenac terrane, Southern Ontario. Geol. Assn. Canada Ann. Mtg. Abstracts 1994.

Dr. Sherwin Desser - Department of Zoology, University of Toronto with Henry Hong, Research Associate and Todd G. Smith - Ph.D. Thesis

"The Morphology, Ultrastructure, and Taxonomic Status of an Intraerythrocytic Virus of Northern Water Snakes from Ontario."

Analysis of blood films made from 26 Northern Water Snakes captured from the vicinity of the Queen's University Biological Station in May, 1992, revealed an intraerythrocytic parasite characterized by translucent inclusions, small red-staining structures, and crystalloid bodies in the cytoplasm of infected cells. One heavily-infected Northern water snake was taken back to Toronto for the purposes of determining the identity of these inclusions. Ultrastructural studies revealed that the cytopathology discerned with light microscopy was a result of the presence of icosahedral virus particles in the cytoplasm of infected erythrocytes. Although extensive alteration to erythrocytes was observed, the infected snake did not appear to be adversely affected. The likeness of this virus to *Toddia*, a similar virus which has been described from all groups of poikilotherms, prompted us to reclassify intraerythrocytic icosahedral viruses of snakes as Snake Erythrocytic Virus.

Assistance with the project was generously provided by Dr. Pat Weatherhead, Dr. Mark Forbes, Francis Barry and Kent Prior at the research station.

Publication:

Smith, T.G., S.S. Desser, and H. Hong. 1994. The morphology, ultrastructure, and taxonomic status of *Toddia* in northern water snakes (*Nerodia sipedon sipedon*) from Ontario, Canada. *Journal of Wildlife Diseases* 30: In Press - scheduled to appear in the April issue.

Dr. Sherwin Desser and Dr. Donald S. Martin - Department of Pathology, University of Guelph and Todd G. Smith - Ph.D. Thesis

"The Life Histories, Ultrastructure, and Systematics of Species of Hepatozoon in Snakes from Ontario."

Analysis of blood films made from 26 Northern Water Snakes captured from the vicinity of the Queen's University Biological Station in May, 1992, revealed intraerythrocytic gamonts, or the mature sexual stage, or a type of protozoan parasite called a haemogregarine. Four infected Northern water snakes were taken back to Toronto to determine the life cycle of this parasite. Potential vectors of the parasite in the vicinity of the QUBS, including leeches (*Placobdella ornata*) and mosquitoes (*Culex pipiens* and *C. territans*), were allowed to feed on the infected snakes. The parasite underwent sexual reproduction in the mosquitoes, ultimately forming large oocysts filled with sporozoites in the body cavity of the insect. This pattern of development allowed us to determine that the parasite was a member of the genus *Hepatozoon*. Small cysts of the parasite were found in the liver of Northern leopard frogs that had been fed mosquitoes containing oocysts. Asexual division in the form of merogony occurred in

Northern water snakes and Eastern garter snakes that had been fed infected frogs. The novel life cycle and the unique morphological features of the parasite at various developmental stages allowed us to describe a new species of *Hepatozoon*. In July, 1993, eight Eastern garter snakes were sampled for blood parasites from marshes near QUBS. Three of these snakes contained a haemogregarine similar in appearance to that found in the Northern water snake. However, the cytopathology of the host cell was markedly different which raised the possibility that this parasite was a distinct species. The life cycle of this parasite is currently under investigation.

Assistance with the project was generously provided by Dr. Pat Weatherhead, Dr. Mark Forbes, Francis Barry, and Kent Prior at the research station.

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

"Evolutionary ecology of invertebrates"

My research interests transcend several subdisciplines of invertebrate ecology and evolution. In particular, I am interested in factors favoring the evolution of polymorphism in insect populations, the importance of parasites in determining insect reproductive success, and factors important in determining patterns and processes in invertebrate communities (as well as other research questions).

Publications:

Forbes, M.R.L., Weatherhead, P.J., Bennett, G.F. (in press) Blood parasites of blue grouse: interspecific associations. *Oecologia* (Berlin).

Forbes, M.R.L., Teather, K.L. (in press) Variation in male responses to female morphs in *Enallagma ebrium*. *Odonatologica* 23:

Forbes, M.R.L. (in press) Tests of hypotheses for female-limited polymorphisms in the damselfly, *Enallagma boreale* Selys. *Animal Behaviour*.

Forbes, M.R.L. 1993. Parasitism and host reproductive effort. *Oikos*, 444-450.

Sherry, D.F., Forbes, M.R.L., Kurgel, M., Ivy, G.O. 1993. Females have a larger hippocampus than males in the brood parasitic brown-headed cowbird. *Proceedings of the National Academy of Sciences (USA)* 90:7839-7843

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, to determine whether this variation follows the predictions of life-history theory. In a previous study on 27 pumpkinseed populations in eastern and central Ontario, I showed that populations living sympatrically with bluegill sunfish, a congeneric competitor at the juvenile stage, exhibited delayed maturity and low-reproductive investment relative to allopatric populations of this species. To determine whether these differences are directly attributable to competition with bluegill, I began a long-term manipulative experiment in the spring of 1993. 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.

Reproductive life history characteristics will be monitored in these and two control populations, along with pumpkinseed population structure, and juvenile and adult density of both species over a ten year period.

Assistants: Kirk Bertschy, Dwane Peltzer, Stacey Robb

Kirk Bertschy - "The Influence of Age-Specific Mortality Rates 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 mortality (as predicted by life history theory); and (2) if there is a mortality cost to maturation and reproduction. Mark-recapture studies were undertaken in five eastern and central Ontario lakes in the spring of 1993 to provide the basis for age-specific mortality rate estimates. Approximately 2,000 pumpkinseeds in two of the lakes were captured during the reproductive period (including nesting males). These fish were assessed for maturity status and tagged. Recapture of these fish next year will provide the basis for assessing the mortality cost of maturation and reproduction.

Dwayne Peltzer - "Comparison of Abiotic and Biotic Characteristics of Waterbodies With Sympatric and Allopatric Populations of Sunfish" - B.Sc. Thesis

The purpose of this study is to determine whether life history differences in pumpkinseed populations living in waterbodies with or without bluegills can be explained by environmental differences in habitat. Ten waterbodies were used for this study, five with sympatric and five with allopatric populations. (The former include Lake Opinicon and Upper Rock Lake.) Variables assessed in littoral zone sites included chlorophyll a concentration, zooplankton and benthic invertebrate density, macrophyte cover, and fish community composition. Assessments were conducted in May, July and August.

Stacey Robb - "Effect of Bluegill on Juvenile Pumpkinseed Diet and Growth" - B.Sc. Thesis

The purpose of this study is to test for competition among juvenile sunfishes, an important element of the two stage life history theory of Osenberg et al. (1992). I hypothesized that juvenile sunfish density would be higher, and growth and food consumption would be lower in juvenile pumpkinseeds living sympatrically with bluegill. The study was conducted in the same waterbodies used for D. Peltzer studies. Juvenile sunfish body size and density was assessed in littoral zone sites in each lake from sampling in May, July and August. Samples of both species were retained for stomach content analysis to determine quantity, food composition and niche breadth.

Publications:

Fox, M. G. Growth, density and interspecific influences on pumpkinseed life histories. Ecology (in press).

Danylchuk, A. J., and M. G. Fox. Seasonal reproductive patterns of pumpkinseed (*Lepomis gibbosus*) populations with varying body size characteristics. Can. J. Fish. Aquat. Sci. (in press).

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

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

"Insect sensory ecology and neuroethology"

"Jamming bat echolocation: the clicking response of the dogbane tiger moth to the attack sequence of the big brown bat."

Certain tiger moths emit high frequency clicks to an attacking bat causing it to break off its pursuit. The hypothesized mechanisms of how the sounds act is that they either orient the bat by providing it with information that it uses to make an attack decision (aposematism) or they disorient the bat by interrupting the normal flow of echo information required to complete a successful capture (startle, jamming). An important question in this controversy is at what point during a bat's attack does an arctiid emit its clicks. If the sounds are aposematic, the moth should emit them soon in the attack echolocation sequence in order to allow the bat time to understand their meaning. If, on the other hand, the sounds disrupting the bat's echo-processing behaviour, one would expect them to be emitted later in the attack to maximize their confusion effects. To test this, we exposed dogbane tiger moths (*Cynia tenera*) to a recording of the entire echolocation sequence emitted by a big brown bat (*Eptesicus fuscus*) as it attacked a stationary target. These experiments demonstrate that *C. tenera* does not respond to search or approach calls but waits until the bat's terminal phase before it emits its clicks. This timing is evident whether the moth is stationary or flying and is largely independent of the intensity of the echolocation calls. These results support a jamming effect (e.g., "phantom echoes") and suggest that to experimentally determine the effects of arctiid clicks on bats it is important that the bats be tested under conditions that simulate the natural context in which this defence operates.

Jeff W. Dawson - "Neurophysiological characterization of the central pattern generator controlling sound production in the dogbane tiger moth (*Cynia tenera*) and the milkweed tussock moth (*Euchaetes egle*)" - M.Sc. Thesis

Certain tiger moths respond to the echolocation calls of an attacking bat by producing ultrasonic clicks from laterally paired tymbal organs located on their metepisterna. The neural mechanism is interesting because the tymbals on each side of the moth are rhythmically activated in alternation at a constant phase. For my M.Sc. thesis, I am characterizing and comparing the neural impulses that are responsible for activating the musculature of the tymbal organs in the dogbane tiger moth, *Cynia tenera*, and the milkweed tussock moth, *Euchaetes egle*. During the summer of 1993, I found that the neural circuitry specific for activating the tymbals is confined to the 2nd and 3rd thoracic ganglia in *C. tenera*, and noticed that the cephalic ganglia function to reinforce the output from this circuit. It was also found that the 1st thoracic ganglion was necessary for auditory activation of the tymbals and I believe this is because the auditory neural pathway extends to this anterior ganglion. *E. egle*, is a species phylogenetically close to *C. tenera* but shows many differences in the neural impulses that activate the tymbals. Specifically, the envelope of the tymbal activating impulse is multi-peaked and broader than that recorded from *C. tenera* and in *E. egle*, the left and right tymbals can be activated unilaterally, an observation not (often) made of *C. tenera*. To better understand the role of cephalic centres in reinforcing the tymbal central pattern generator (CPG), I developed a technique of activating the tymbal CPG using constant current electrical stimulation of the thoracic ganglia. This technique will also facilitate other projects aimed at identifying specific neurons of the tymbal CPG in *C. tenera*, *E. egle*, and other tiger moths by future students working at QUBS.

Francine P. Lewis - "Neurometamorphosis of the ear in the Gypsy Moth, *Lymantria dispar* (Lymantriidae)" - M.Sc. Thesis

Some moths such as the gypsy moth have simple ears on their metathoracic segment, while other moths such as the forest tent caterpillar moth are earless. The ear of the adult moth consists of a tympanum and an auditory sensillum consisting of two auditory neurons, while the homologous sensillum in the earless moth is a stretch receptor consisting of three neurons. The larva of the gypsy do not have ears but acquires them through metamorphosis for the adult stage. My M.Sc. research has focused on identifying and characterizing the putative precursor sensillum in the larva of the eared moth and comparing it to the homologous organ in the larva of the earless moth. Further studies also document the changes the larval organs undergo during metamorphosis to their respective condition (eared or earless) in the adult stage.

My research to date has revealed a putative precursor sensillum on the homologous nerve branch in both the eared and earless larva. The sensillum in both larval species is a chordotonal organ containing three sensory nerve cells. In the eared adult the central nervous system projections consists of two auditory neurons, A1 and A2 and sometimes a closely associated non auditory neuron (B). A1 and B both project at least to prothoracic ganglion while the A2 only projects to the mesothorax. In both species of larva there are projections of at least four sensory cells of which one is confined to the meta and mesothoracic ganglia while the others project at least as far anterior as the pro- to mesothoracic connectives. Although I cannot be sure which of the cells are the putative precursors to A1 and B, I propose that the larval cell that projects only into the meso and metathoracic ganglia is the putative precursor to the A2 cell. I have also attempted to ablate the precursor larval sensillum in the last larval instar to determine the effects on the development of the ear. The results so far suggest that removal of the putative larval precursor sensillum results in the loss of the auditory sensillum in the ear of the adult.

Publications:

- Fullard, J.H. and Yack, J.E. 1993. The evolutionary biology of insect hearing. *Trends. Ecol. Evol.* 8:248-252.
- Lewis, F.P., Fullard, J.H. and Morrill, S.B. 1993. Auditory influences on the flight behaviour of moths at a Nearctic site. II. Flight times, heights and errataicism. *Can. J. Zool.* 71:1562-1568.
- Yack, J.E. and Fullard, J.H. 1993. What is an insect ear? *Ann. Ent. Soc. Amer.* 86:677-682.
- Yack, J.E. and Fullard, J.H. 1993. Proprioceptive activity of the wing-hinge receptor in *Manduca sexta* and other atympanate moths: a study of the noctuid moth ear B cell homologue. *J. Comp. Physiol.* (in press)

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

"Evolutionary and behavioural ecology of fish reproduction"

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

"Reproductive dynamics in Bluegill Sunfish"

Luca Cargnelli supervised the 1993 collection of bluegill reproduction data including dates, colony sites, nest numbers and male reproductive success. This adds to the five-year collection of Julie Claussen (1985 - 1989), the two-year collection supervised by James McGuire (1990 - 1991) and the 1992 collection previously supervised by Luca, providing nine years of continuous records in the Fish Reproduction Study Area. Luca plans to use these data in his M.Sc. thesis described below.

Assistants: Bryan Neff, Louise Porto and Erin Baker

"Cuckoldry in Bluegill Sunfish"

Paternity data are being collected for individuals per cuckoldry intrusion, for different nest locations within colonies, and for different colonies to determine the success of cuckold and parental males in Bluegill Sunfish. Samples of fry and adult tissue were collected from most colonies in the Fish Reproduction Study Area. The work was supervised by Helen Han and Joe Justus. Meanwhile, John Colbourne worked in the Marine Gene Probe Lab at Dalhousie University, developing techniques for analyzing tissue samples using microsatellite DNA technology. In September, John entered Guelph University and Bryan Neff assumed the responsibility for the DNA-based

paternity analyses. Mike Cummings also worked on a dynamic programming model to explain the distribution of cuckold males among bluegill colonies.

Assistants: Erin Baker, Luca Cargnelli, Mike Cummings, Helen Han, Joe Justus, Bryan Neff, Louise Porto and Naomi Sanderson.

Thesis:

Cote, Isabelle M. 1993. The evolution of sociality in fishes with emphasis on the role of parasites. Ph.D. Thesis, Department of Zoology, University of Toronto, Toronto, Ontario.

Publications:

Cote, I.M. and M.R. Gross. 1993. Reduced disease in offspring: a benefit of coloniality in sunfish. *Behav. Ecol. Sociobiol.* 33:269-274.

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. In Bluegill Sunfish, males provide parental care for their young and often desert their nests before their clutch has matured. Also, males and colonies vary considerably in the number of females they attract. In 1993, habitat assessment data, male reproductive success data and male morphology data were collected for all bluegill colonies in the Fish Reproduction Study Area. Patterns of within-season reneesting were also examined by tagging males nesting early in the season and following them through subsequent bouts of spawning. These data will be combined with previous years of bluegill reproduction survey data to determine how male behaviour affects reproductive output in our study population.

Assistants: Bryan Neff and Louise Porto.

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. Male pumpkinseed provide sole parental care. Males establish and defend discrete nest sites in shallow water during late spring and early summer. Nests are visited by females and are aggressively courted by the nesting males. Females typically visit two to seven nests prior to spawning with any male. Once the female has chosen a male, she appears to spawn all her eggs with him. The objective of my research is twofold. First, I want to determine what characteristic or cue females use in mate choice and, second, what benefits in fitness they receive from their choice. Comparisons between chosen and non-chosen males collected in Lake Opinicon will be used to identify which characteristic(s) or cue(s) females use. These characteristics will be manipulated and quantified with breeding experiments conducted in our pool facility at QUBS. Progeny of chosen and non-chosen male pumpkinseed will be reared in a common environment and compared to determine if the female has received a genetic benefit for her young as a result of her choice of mate.

Assistant: Erin Baker

Dr. David Philipp and Julie Claussen - Center for Aquatic Ecology, Illinois Natural History Survey

"Natural hybridization events between Bluegill and Pumpkinseed in Lake Opinicon"

This research focuses on the natural hybridization that occurs between bluegill and pumpkinseed. Not only do bluegill and pumpkinseed reproductive seasons overlap, but some of the habitat that each species prefers to build nests in and spawn also overlaps. Research in our lab has shown that small sneaker male bluegill cuckold (steal fertilizations) spawning pairs of pumpkinseed, resulting in hybridization between these two species. As an ongoing research project, we are studying the various costs and benefits of these hybridization events. Using electroshocking techniques, we are also continuing to assess the relative proportions of the two sunfish species and their hybrids in the population.

Assistants: Todd Kassler, Marc Desjardins, and Dave Philipp

Dr. David Philipp and Dr. John Epifanio - Illinois Natural History Survey and Virginia Commonwealth University

"Genetics of sunfish hybrids in Lake Opinicon"

Bluegill and pumpkinseed were collected from the lake and gametes from each, as well as from male warmouth and redbreast sunfish from Virginia were extracted and used for *in vitro* fertilizations to make F1 hybrids. Embryos were raised and sampled at various developmental stages. Using molecular techniques, we are determining when certain genes turn on during development, and if the parental genes are expressed at equal or unequal levels. In addition, these *in vitro* crosses were transported to Illinois where they were raised in outdoor ponds until they were large enough to be collected. These YOY (young-of-year) hybrids were then used to determine the inheritance of RAPDS (randomly amplified polymorphic DNA).

Assistants: Todd Webb and Todd Kassler

Dr. David P. Philipp and Frank Phelan - Center for Aquatic Ecology, Illinois Natural History Survey and Queen's University

"Catch-and release angling of Largemouth and Smallmouth Bass"

Experimental angling was conducted at the St. Lawrence River, Charleston Lake, and Lake Opinicon for both largemouth and smallmouth bass. During the angling, aspects of the handling and release, such as time in the boat, distance from the nest, etc. were varied. Data taken from captured-and-released bass such as male size, brood developmental stage, egg score, return time, predation rates etc. will be used to determine how catch-and-release angling impacts the reproductive success of both species, by measuring return-to-nest times and abandonment rates.

Assistants: David B. Philipp, Heather Ferguson and Brian Bagatto

"Movement of Smallmouth Bass"

The mating success of smallmouth bass was monitored in the Mississippi River between Ragged Chute and Miller Lake. These pools have historically had high concentration of smallmouth bass in the past, although little is known about their movements within this section of the stream within a season and among years. In June nesting and non-nesting fish were caught, weighed, measured, fin-clipped and tagged to identify location, and released at the point of capture. More non-nesting fish were caught in October and handled similarly. Movements and spawning location fidelity will be assessed this coming summer.

Assistants: David B. Philipp, Todd Kassler, Marc Desjardins, Jim Ludden, Heather Ferguson, and Brian Bagatto

"Largemouth and Smallmouth Bass Reproductive Success"

This was the fourth year of study on largemouth and smallmouth bass reproductive success, supported by the Ontario Ministry of Natural Resources, Queen's University, and the Ontario Federation of Anglers and Hunters. Intensive monitoring of spawning success, the duration of nesting, and parental care behavior in both species continued to be documented at Lake Opinicon, and compared test sites open to normal fishing regulations versus a control area that was closed to all fishing prior to the opening of the bass fishing season.

Assistants: David B. Philipp, Heather Ferguson and Brian Bagatto

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

"Water mite parasitism of Aquatic Insects"

"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 species of mites in which some individuals had normal larvae that are ectoparasites of insects, while others had non-feeding larvae that forgo parasitism. In 1992 Seth Ettenberg and I more closely examined these species and concluded that each species, as currently defined, was actually a pair of sibling species in which one species has parasitic larvae while the other has non-parasitic larvae. This was based on morphological characteristics. We continued this work in 1993, testing for reproductive isolation. Individuals of different species within a sibling pair would readily mate and produce larvae, for reciprocal crosses and in both sibling pairs. Inheritance of larval characteristics was not Mendelian: the need for a host was determined by the maternal line, while most morphological characteristics (e.g., length of leg segments, degree of sclerotization) was determined by the paternal line. Offspring from crosses with females from the lineage with non-feeding larvae and males from the lineage with parasitic larvae 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 (mother from the lineage with parasitic larvae and father 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 conclude apparent asymmetrical success in development to adult represents partial reproductive isolation between species within each sibling species pair. In 1994 I intend to conduct breeding experiments involving reciprocal crosses and backcrosses of the F1 hybrids to determine whether inheritance of larval traits continue to show maternal and paternal determination, and whether there is reproductive failure in production of the F2 generation.

Assistant: Jessica Morrow

B. "Indirect estimates of gene flow in *Arrenurus* water mites" - Andrew J. Bohonak, Cornell University, and Dr. Bruce P. Smith, Ithaca College.

For many aquatic invertebrates, estimating rates of dispersal is most easily accomplished by examining genetic markers from many different populations. Comparing these indirect estimates for taxa known to differ in intrinsic dispersal capability allows an evaluation of their accuracy. Preliminary surveys for populations of *Arrenurus* water mites were conducted in the spring of 1993. Within this single genus, different species parasitize dragonflies, mosquitoes, or midges while utilizing them as vectors of dispersal. Some species even forgo parasitism (and host-assisted dispersal) entirely. A comprehensive roadside survey for 33 species was begun throughout the areas surrounding QUBS. Twelve new and 4 previously known sites were sampled for mites, which were identified and

stored for isozyme studies. Sampling and electrophoretic surveys will continue in 1994.

Assistant: Jessica Morrow

Jessica Morrow - "Guild structure of dragonflies and their parasitic mites" - B.Sc. Thesis

The purpose of this study was to survey dragonfly populations and the mites infesting them. Competition theory would suggest that when resources are limiting, there would be resource partitioning among potentially competing species of mites. The hypothesis in this project is that guild structure of parasitic mites on dragonflies does **not** reflect strong competition among mite species:

1. there would be extensive interspecific multiple parasitism (more than one species of parasite on the same host)
2. most species of mites would be generalists, regularly parasitizing a broad range of dragonfly species.

Dragonflies on the wing were sampled weekly at three sites: QUBS station road, Telephone Bay, Lindsay Lake Road. A total of 1976 dragonflies belonging to 36 species were sampled from mid-May to late July, yielding 36,684 larval mites belonging to at least 10 species (identifications are underway, and at least three species new to science have been discovered). Species of Aeshnidae, Macromiidae and Gomphidae are very rarely parasitized, and when infested, an individual carries only 1 - 5 mites. Species of Corduliidae are rarely parasitized, but when parasitized, individuals can carry several hundred mites. The vast majority of larval mites infest species of Libellulidae, with abundance (= arithmetic mean) being about 60-fold greater than any other group of dragonfly. *Erythemus simplicicollis* was the most-heavily infested species, with an abundance of over 240 mites per host and individuals with up to 850 mites. Several species of dragonfly have such intense levels of infestation and individuals of these species regularly carry four or more species of mites (interspecific multiple parasitism). The species of mites involved are not species-specific, but typically infest a broad diversity of libellulid species. One interesting relationship that was discovered is that *Sympetrum internum* and *Sympetrum obtrusum* are heavily infested by the same species of mite, yet the mites are always dead and unengorged on the former host yet very rarely fail to engorge on the latter.

Publications:

Proctor, H.C., and B.P. Smith. 1994. Mating behaviour of the water mite *Arrenurus manubriator* Marshall (Acari: Arrenuridae). *Journal of Zoology*, IN PRESS.

Dr. Kevin Teather - Department of Biology, Augustana College, Camrose, Alberta

I - "Growth and asymmetry of nestling Common Grackles (*Quiscalus quisculus*)"

Stress during development is thought to influence asymmetry of certain paired characters (eg. limb length). Asymmetric development of certain structures might arise if an individual is subjected to stressful conditions during the early part of its life or if the individual, because of a poor phenotype, is unable to cope with these conditions. I studied a population of Common Grackles to examine if growth rates (a measure of how well a nestling grows) are negatively correlated with the asymmetric development of certain characters. I found that nestlings having high growth rates for tarsus and primary feathers are also more symmetric in the development of these characters than nestlings having lower growth rates.

II - "The importance of nestling movement in food acquisition in American Robins"

Work carried out at QUBS by McRae, Weatherhead and Montgomerie suggested that nestling robins jockey

for better feeding positions in the nest. To experimentally test this idea, I videotaped a series of robin nests before and after restricting nestling movements. The slow process of analyzing these videos is to begin shortly.

III - "The influence of age and prior access to females on male cowbird dominance hierarchies"

Collaborator: Dr. Pat Weatherhead - Department of Biology, Carleton University

In 1993, Pat Weatherhead and I completed a two-year examination of captive male Brown-headed Cowbird dominance. The study focussed on whether subordinate males become dominant if provided with access to a female before being reunited with the previously dominant male. The results suggested that dominance among males did switch in about 25% of the trials, although there was no evidence that switching was related to the presence of the female.

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

"Mate Choice in Red-winged Blackbirds"

Collaborator: Dr. Peter Boag (Queen's)

The goal of this long-term project is to test several mate-choice hypotheses using red-winged blackbirds, and by repeating this research over a long period (7 years) using a marked population, to determine lifetime mating strategies and lifetime reproductive success of known individuals. The importance of this project is that mating behaviour is being determined using DNA fingerprinting, so a true measure of individual reproductive success will be obtained. Data collection was completed last year and fingerprinting was completed this year. Data analysis and writing are now underway.

Assistant: Kit Muma

Greg Brown - "Sexual Selection in Northern Water Snakes" - PhD Thesis

During the mating season, receptive female northern water snakes are often courted by several males simultaneously. In most animals, competition among males for access to females is associated with the evolution of sexual size dimorphism, where males are larger than females. However, female northern water snakes grow much larger than males, suggesting that attributes other than large size contribute to male mating success in this species. Previous work suggested that intermediate-sized males may be more competitive because their energy reserves relative to their body size are greater. This study, initiated in 1993, is using radio-telemetry to investigate behavioural energetics of water snakes relative to sex and body size. The study will be expanded in 1994 to include DNA-based analyses of paternity.

Assistant: Perry Comm

Kevin Dufour - "Bilateral asymmetry and reproduction in Red-winged Blackbirds" - Ph.D. Thesis

Recent work on insects and on certain birds suggests that subtle developmental inconsistencies can have consequences for an individual's reproductive output later in life. Specifically, several studies have demonstrated an inverse relationship between bilateral asymmetry (a product of developmental instability) and male mating success. The mechanisms underlying the phenomenon are unknown. In 1993, I initiated a study that will examine several aspects of asymmetry in free-living Red-winged Blackbirds, with particular emphasis on the reproductive consequences of asymmetry for individual males. The primary aim of the 1993 field season was to determine the

relationship between asymmetry and annual reproductive success among territorial males breeding at several marshes in and around QUBS. This involved sampling blood from all adults and associated nestlings so that true reproductive success could be determined through DNA fingerprinting. Work on this project will continue in 1994.

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 seven hibernacula across the Rideau Lakes Region during the spring of 1993 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). Comparisons will be made between this population and those sampled from southern Ontario, Ohio, and Maryland in order to assess the role that population size and bottleneck severity may play in determining genetic variation. Genetic analyses are being done in collaboration with Dr. H. Lisle Gibbs (McMaster).

Assistant: Terri Taylor

Stephen Yezerinac - "Plumage variation and male reproductive strategies in yellow warblers" - PhD Thesis

Male yellow warblers exhibit substantial variation in plumage brightness which, in previous studies, has been shown to be correlated with male parental behaviour and territory quality. The hypothesis being tested in this study is that bright males are higher quality and reduce their parental care so they can pursue extra-pair mating opportunities. Preliminary DNA fingerprinting analysis from 1992 indicated that extra-pair fertilizations were quite common. Further analysis of those samples plus analysis of samples collected in 1993 is nearing completion. Full data analyses will follow. Next year the study will be repeated in a very high density population to assess how breeding density affects overall levels of extra-pair mating and the specific male strategies underlying that phenomenon.

Publications:

Barry, F.E., P.J. Weatherhead and D. P. Philipp. 1992. Multiple paternity in a wild population of northern water snakes (*Nerodia sipedon*). *Behav. Ecol. Sociobiol.* 30: 193-199.

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

Forbes, M.R.L., P.J. Weatherhead and G.F. Bennett. 1994. Blood parasites of blue grouse: interspecific associations. *Oecologia* (Berlin), in press.

Gibbs, H.L., K.A. Prior and P.J. Weatherhead. 1994. Genetic analyses of populations of threatened snake species using RAPD markers. *Mol. Ecol.*, in press.

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. 1992. Seeing red: uncovering coverable badges in red-winged blackbirds. *Anim. Behav.* 43: 223-229.

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.

Robertson, I.C. and P.J. Weatherhead. 1992. The role of temperature on microhabitat selection by northern water snakes (*Nerodia sipedon*). *Can. J. Zool.* 70: 417-422.

Scott, D.M., P.J. Weatherhead and C.D. Ankney. 1992. Egg-eating by female brown-headed cowbirds. *Condor* 94: 579-584.

Shutler, D. and P.J. Weatherhead. 1992. Surplus territory contenders in red-winged blackbirds: where are the desperados? *Behav. Ecol. Sociobiol.* 31: 97-106.

Shutler, D. and P.J. Weatherhead. 1994. Movement patterns and territory acquisition by floater red-winged blackbirds. *Can. J. Zool.*, in press.

Teather, K.L. and P.J. Weatherhead. 1994. Allometry, adaptation and the growth and development of sexually dimorphic birds. *Oikos*, in press.

Weatherhead, P.J. 1994. Mixed reproductive strategies by females may strengthen the sexy son hypothesis. *Anim. Behav.*, in press.

Weatherhead, P.J. 1994. Effects of familiarity and experience among male red-winged blackbirds on female reproductive success. *Anim. Behav.*, in press.

Weatherhead, P.J. and G.F. Bennett. 1992. Ecology of haematophagous parasitism in brown-headed cowbirds. *Can. J. Zool.* 70: 1-7.

Weatherhead, P.J. and R.G. Clark. 1994. Natural selection and sexual size dimorphism in red-winged blackbirds. *Evolution*, in press.

Weatherhead, P.J. and M.R.L. Forbes. 1994. Natal philopatry in birds: genetic or ecological influences? *Behav. Ecol.*, in press.

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. and I.C. Robertson. 1992. Thermal constraints on swimming speed and escape response of northern water snakes. *Can. J. Zool.* 70: 94-98.

Weatherhead, P.J. and K.L. Teather. 1994. Sexual size dimorphism and egg size allometry in birds. *Evolution*, in press.

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

Documentation of Research Use of QUBS in 1993 - User-Days

User	Supervisor	Post-Doc	Graduate Student	Assistant	TOTAL
INTERNAL (QUEEN'S)					
Aarssen	10	0	30	30	70
Briskie	11	0	0	22	33
Crowder	0	0	0	6	6
Eckert	26	0	0	6	32
Harmsen	0	0	0	6	6
Keast	25	0	0	0	25
Montgomerie	12	0	0	10	22
Phelan	N/A	0	0	172	172
Ratcliffe	6	0	59	107	172
Robertson	120	72	179	372	743
Smol	0	0	6	6	12
Tufts	6	0	6	44	56
Wynne-Edwards	0	0	0	29	29
Total Internal	216	72	280	810	1378
EXTERNAL					
University of Toronto					
Baker (R.O.M.)	0	0	3	3	6
Baker (Erindale)	2	0	6	6	14
Barrett	3	0	0	3	6
Desser	0	0	0	6	6
Eadie	4	0	12	0	16
Fullard	100	0	204	94	398
Gross	8	0	154	290	452
Gwynne	1	0	0	1	2
Carleton					
Weatherhead	77	0	348	369	794
Illinois Natural History Survey					
Philipp	48	19	5	117	189
Univ. of Regina					
Forbes	8	0	0	0	8
Ithaca College					
Smith	115	0	0	81	196
Miami University					
Bjornerud	5	0	41	41	87
Trent University					
Berrill	3	0	0	3	6
Fox	0	0	4	4	8
Augustana College					
Teather	73	0	0	0	73

User	Supervisor	Post-Doc	Graduate Student	Assistant	TOTAL
Total External	447	19	777	1018	2261
TOTAL RESEARCH USER-DAYS	663	91	1057	1828	3639
% Queen's	33	79	27	44	38
% Non - Queen's	67	21	73	56	62

USER-DAYS IN TEACHING ACTIVITIES 2316

CONFERENCE AND FIELD TRIP USE 488

OTHER* 1076

Grand Total User-Days in 1993 7519**

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

(** up 4% from 1992)

Summary of Conference, Meeting and Field Trip Use of QUBS in 1993

Organizer	Function	Number of Participants	Duration
Dr. D. Bastianutti (Queen's - Italian)	Italian Club - Italian Immersion Weekend	12	Jan. 22- 24
Colleen Barber (Queen's - Biology)	Reunion Weekend	33	Jan. 29- 31
Dr. R. Harmsen (Queen's - Biology)	Bio 428 (Population Ecology) Weekend	15	Feb. 5-7
Mark Kaemmerer (Queen's - Law)	Environmental Law Association Meetings	6	Mar. 12- 13
Dr. R.J. Robertson (Queen's - Biology)	Bio 533 (Conservation Biology) Weekend	13	Mar. 20- 21
Dr. S. Thompson (Sir Sandford Fleming)	Natural Resources Field Course Group 1	35	Apr. 19- 21
	Natural Resources Field Course Group 2	37	Apr. 21- 23
Mark Millan (Lancaster Public School)	Canoe Trip and Station Tour	25	June 1
Jim Atack (Rideau Valley Field Naturalists)	RVFN Meeting and Station Tour	25	June 6
Mark Millan (Lancaster Public School)	Canoe Trip and Station Tour	25	June 7
Doug Kirkland (RWLC - Portland)	Rideau Waterway Land Conservancy Meeting	6	June 10
Mark Millan (Lancaster Public School)	Lancaster School Teaching Staff Tour of Station	12	June 29
Jack Gray (Queen's - Biology)	Entomology Collecting Trip	5	July 20- 22
Dr. R.J. Robertson (Queen's - Biology)	Forest Songbird Monitoring Workshop	28	July 21
Brian Barkley (EOMF - Brockville)	Eastern Ontario Model Forest Meeting and Workshop	17	July 22
Dave Chapeski (OMNR - Brockville)	Brockville District of Ontario Ministry of Natural Resources Meeting and Workshop	12	Aug. 13
Dr. Adele Crowder (Queen's - Biology)	Field Botanists of Ontario Field Trip	16	Aug. 21

Organizer	Function	Number of Participants	Duration
Dr. Ed Kott (Wilfrid Laurier - Biology)	Wilfrid Laurier Senior Undergraduate Field Course	22	Aug. 29-Sept. 11
Ken Otter (Queen's - Biology)	Bio 302 (General Ecology) Weekend - Group 1	61	Sept. 17-19
	Bio 302 (General Ecology) Weekend - Group 2	67	Sept. 24-26
	Bio 302 (General Ecology) Weekend - Group 3	69	Oct. 1-3
Dr. Roland Hall (Queen's - Biology)	Bio 335 (Limnology) Field Trip - Group 1	35	Oct. 2
	Bio 335 (Limnology) Field Trip - Group 2	38	Oct. 3
Dr. V. Remenda (Queen's - Geological Sciences)	Hydrogeology Field Trip Group 1	67	Oct. 16
	Hydrogeology Field Trip Group 2	52	Oct. 17

Queen's University Biological Station List of Theses

Updated March 11, 1994.

Ph.D. THESES:

- AGBETI, M.D. 1993. Comparison of seasonal succession of phytoplankton in two lakes with different mixing regimes. Ph.D. thesis. Department of Biology, Queen's University, Kingston, Ontario.
- BARCLAY, R. M. R. 1981. Interindividual use of echolocation calls: Eavesdropping by the Little Brown Bat, *Myotis lucifugus*. Ph.D. thesis. Department of Biology, Carleton University, Ottawa, Ontario.
- BROWN, J. A. 1983. A comparative study of behavioural ontogeny in four species of centrarchid fish. Ph.D. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- CAVALCANTI, R. B. 1981. Nest desertion: Theory and tests of its adaptive significance in birds. Ph.D. thesis, Department of Biology, McGill University, Montreal, P.Q.
- CONRAD, K.F. 1991. Allocation of reproductive effort in Eastern Phoebes (*Sayornis phoebe*). Ph.D. Thesis. Department of Biology, Queen's University, Kingston, Ontario.
- COTE, Isabelle M. 1993. The evolution of sociality in fishes with emphasis on the role of parasites. Ph.D. Thesis, Department of Zoology, University of Toronto, Toronto, Ontario.
- ECKERT, C.G. 1993. The evolutionary maintenance of a sexual polymorphism in clonal *Decodon verticillatus* (L.) Ell. (Lythraceae). Ph.D. thesis. Department of Botany, University of Toronto, Toronto, Ontario.
- ELRIFI, I.R. 1986. Processes during nitrogen-induced photosynthetic suppression in N-limited microalgae. Ph.D. thesis. Department of Biology, Queen's University, Kingston, Ontario.
- EPP, G.A. 1989. Field experiments on interspecific plant interactions during succession in two abandoned hayfield plots. Ph.D. thesis. Department of Biology, Queen's University, Kingston, Ontario.
- FULLARD, J. H. 1979. Auditory components in the defensive behaviour of certain tympanate moths. Ph.D. thesis, Department of Biology, Carleton University, Ottawa, Ontario.
- FULTHORPE, R.R. 1990. Survival, activity and transfer of a bacterial catabolic transposon in an aquatic system. Ph.D. thesis, Department of Biology, Carleton University, Ottawa, Ontario.
- GOTCEITAS, V. 1987. Microhabitat selection by bluegills (*Lepomis macrochirus*) avoiding predation. Ph.D. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- GROSS, M. R. 1980. Sexual selection and the evolution of reproductive strategies in sunfishes (*Lepomis*: Centrarchidae). Ph.D. thesis, Department of Biology, Univ. of Utah.
- KINDLER, P.M. 1990. Role of 11-ketotestosterone, testosterone and prolactin in the expression of reproductive behaviors by male bluegill. Ph.D. thesis. Department of Animal Sciences, University of Illinois, Champaign, Illinois.
- KRAMER, H.G. 1982. The song patterning of song sparrows *Melospiza melodia* in relation to territorial defense. Ph.D. thesis, Department of Biology, McGill University, Montreal, Quebec.
- LONKER, S. 1979. Conditions of metamorphism in high grade pelites from the Frontenac Axis, Ontario,

Canada, calculated from experimental and theoretical equilibria. Ph.D. thesis, Department of Geological Sciences, Harvard Univ.

- MEEK, S.B. 1991. Parental investment and the maintenance of monogamy in Eastern Bluebirds *Sialia sialis*. Ph.D. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- MENARD, G. 1986. A genetic approach to the study of morphometric variation in marsh and upland red-winged blackbirds. Ph.D. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- MURPHY, S.D. 1993. The occurrence and consequences of heterospecific pollen transfer: Allelopathic pollen in *Phleum pratense* L. (Poaceae) and the *Hieracium* L. aggregate (Asteraceae). Ph.D. Thesis, Department of Biology, Queen's University, Kingston, Ontario.
- SHUTLER, D. 1991. Dynamics of territory acquisition by red-winged blackbirds. Ph.D. Thesis. Department of Biology, Carleton University, Ottawa, Ontario.
- STUDD, M.V. 1987. Alternative strategies of allocation of reproductive effort in Yellow Warblers. Ph.D. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- VANDER KLOET, S.P. 1971. The North American Blueberries revisited: A taxonomic study of *Vaccinium* section *Cyanococcus* Gray. Ph.D. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- WHITTINGHAM, L.A. 1992. Male parental care and nesting success in red-winged blackbirds. Ph.D. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- WIEDENFELD, D.A. 1988. Ecomorphology and foraging behavior of the yellow warbler, *Dendroica petechia*. Ph.D. thesis. Department of Biological Science, Florida State University
- M.Sc. THESES:**
- AMUNDRUD, J. R. 1970. Ecological interrelationships of the larvae of Perciform fish in Lake Opinicon, Ontario. M.Sc. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- ARNOLD, S. 1986. Reproductive patterns of darters (*Percidae: Etheostomini*): Female mate choice and patterns of allocation of reproductive effort. M.Sc. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- BALLANTYNE, P. K. 1976. Sound production during agonistic and reproductive behaviour in the Pumpkinseed (*Lepomis gibbosus*), the Bluegill (*L. macrochirus*) and their hybrid sunfish. M. Sc. thesis. Department of Biology, Queen's University, Kingston, Ontario.
- BARCLAY, R. M. R. 1978. Vocal communication and social behaviour of the Little Brown Bat, *Myotis lucifugus* (Chiroptera: Vespertilionidae). M.Sc. thesis, Department of Biology, Carleton University, Ottawa, Ontario.
- BARRY, F.E. 1991. Sexual size dimorphism of northern water snakes *Nerodia sipedon*. M.Sc. Thesis. Department of Biology, Carleton University, Ottawa, Ontario.
- BLANCHER, P. J. 1978. Habitat distribution of the Eastern Kingbird (*Tyrannus tyrannus*): The influence of intraspecific competition. M.Sc. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- BOOTH, D. 1984. Energetics, feeding and growth in year II bluegills (*Lepomis macrochirus*) relative to season. M.Sc. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- BOTTOMLEY, E.Z. 1983. The effect of root uptake by *Myriophyllum spicatum* L. on temporal and spatial distributions of bioavailable phosphorus in a littoral sediment. M.Sc. thesis, Department of Biology, Carleton University, Ottawa, Ontario.
- BROWN, K. E. 1977. Feeding and growth performance of Yellow Perch (*Perca flavescens*) in relation to differing backgrounds of resources and potential competitor species. M.Sc. thesis, Department of Biology, Queen's University, Kingston, Ontario.
- BROWN, S. R. 1952. Some aspects of lake soils in relation to the productivity of a lake. M. A. thesis, Department of Biology, Queen's University, Kingston, Ontario.
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Fee Schedule for 1994

Board Charges - Meals only

\$418/month/person	-no obligation for chores
\$290/month/person	-includes obligation for chores on a rotating schedule

Accommodation Charges - Housing only

\$16/month/person	-dormitory (White House or Curran Cottage)
\$32/month/person	-small cabin (Cabins 1-7, 10, shaker and Basswood)
\$64/month/person	-medium cabin (Cabins 12, 13, 14)
\$86/month/person	-large cabin (Cabins 8, 11 and White House Apt.)
\$118/month/person	-Cottage (Keast, Earl, Sumac or Maplewood)

Room and Board Rates for Short-term Visitors

\$175/person	-weekly R&B for field courses - includes a lab fee
\$21.50/day/person	-24 hr. room and board
\$4.00	-breakfast or lunch only
\$7.50	-dinner only
\$9.00/person	-overnight accommodation - academic purposes
\$18.50/person	-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.