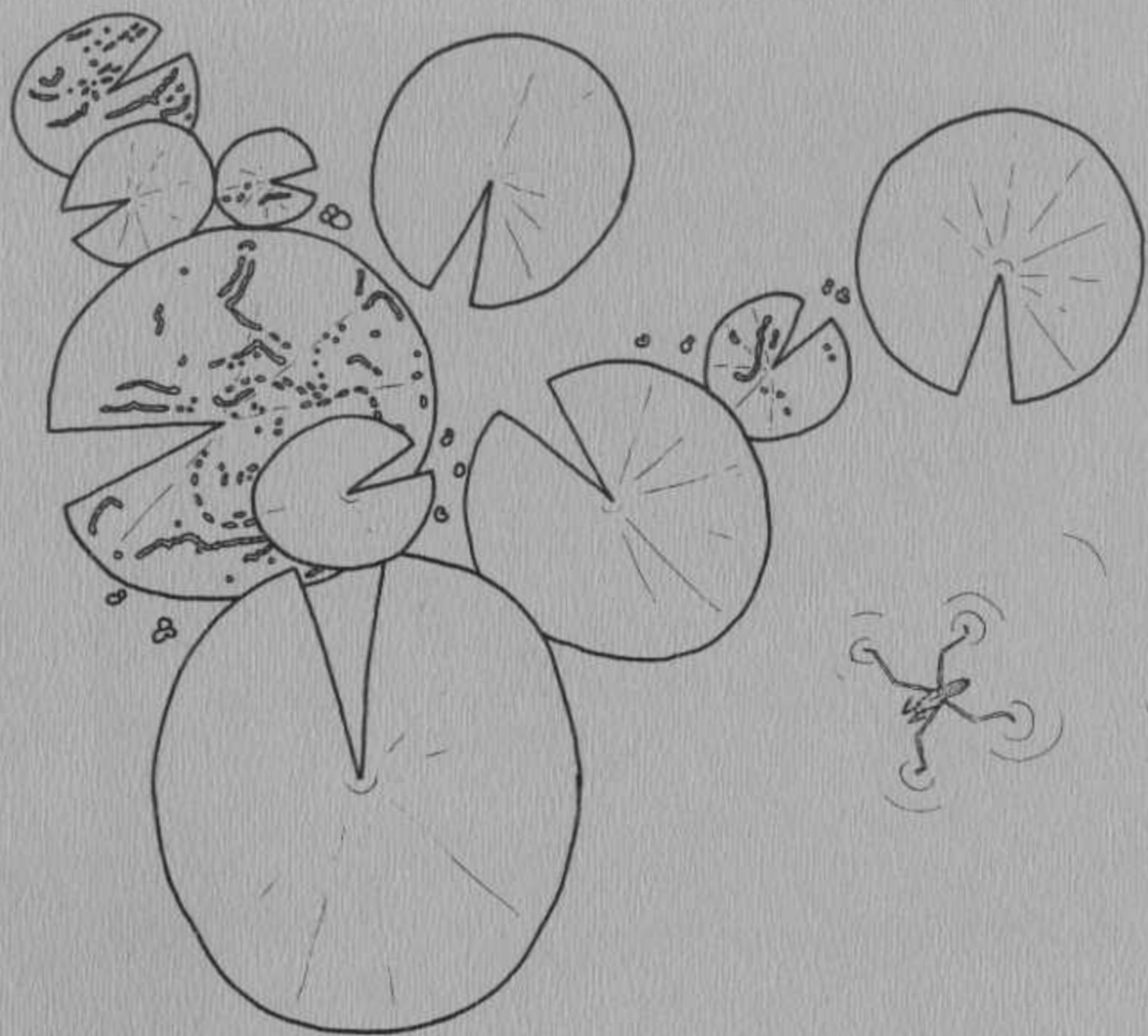


Queen's University Biological Station

Annual Report and Newsletter

1986



Director - Dr. R.J. Robertson

Manager - Frank Phelan

H. WES CURRAN

Dr. Wes Curran, founding director of Queen's University Biological Station, died on 16 April 1987. Wes was a strong supporter of the field station. He played a major role in founding the Station in 1945, and appropriately, he was the first contributor to the recently launched "Opinicon Appeal".

Dr. Curran founded QUBS with the help of Dr. Earl, Head of Biology, and Principal Wallace. He chose the site, negotiated the purchase, and organized and helped with the building of the first buildings. He taught courses in "Economic Vertebrate Zoology" and had an impressive number of students who went on to hold prominent positions in government and universities. Dr. Curran's contributions to the Biology Station were recognized in 1981 with the dedication of the Curran Library. The foresight and dedication which Wes showed in establishing and developing the station will be appreciated by students in field biology for many decades to come.

Nineteen eighty six was once again a year of high levels of research and teaching activity for the Queen's University Biological Station. In research, on average, 32 professors, graduate students, honours students and assistants were in residence through out the summer. Abstracts of research projects and personnel involved are contained in the following pages and are summarized in Table 4. In teaching, QUBS hosted 7 field modules in the Ontario Universities Program in Field Biology. Titles and enrollments for modules held at QUBS and for the OUPFB program in general are found in Tables 1 to 3. The Naturalist Workshop, another integral part of the QUBS teaching program, was again successful with an enrollment of 16. QUBS also provides an extremely important facility for a variety of field trips, especially those associated with fall and winter term University courses (cf. Table 6). In many cases, this exposure to field work is a key element in stimulating interest in field biology.

A very significant "landmark" for QUBS was reached in 1986 with the acquisition of an additional large tract of land for use in teaching and research in field biology. Through the generosity and farsightedness of Allan and Ellen Bonwill, Queen's was able to purchase approximately 1000 acres of the Skycroft property which is adjacent to the Hughson tract, and which has frontage on Lake Opinicon.

The Bonwills offered this large tract of land to Queen's for the very reasonable price of \$50,000.00 because they wish to see the land preserved intact for purposes of teaching, research, and outdoor education. We are very grateful to the Bonwills for their generosity, and we commend their strong commitment and dedication to conservation and education. During the Open House events on July 6, this land was dedicated as the Bonwill Tract. This property will further ensure that QUBS can provide teachers and researchers with accessible, yet relatively undisturbed habitats for the very long term future.

Funding for the purchase of the Bonwill Tract was obtained from a combination of Biology Department (\$12,500) and University (\$25,000) Funds, plus a generous contribution of \$12,500 from the Nature Conservancy of Canada. The latter included a donation of \$5,000 from Sunoco of Canada.

The Sunoco contribution was presented to Dr. Raleigh J. Robertson, Director of QUBS, by Mr. Jerry Henderson in a ceremony held in the courtyard at Earl Hall on 6 June 1986. Also attending that ceremony were Mr. Charles Sauriol of the Nature Conservancy of Canada, Dennis Reid, Chairman, and Bill Warwick, General Manager of the Cataraqui Conservation Authority, who have been instrumental in supporting Queen's acquisition of the property, Dave Canvin, Dean of Graduate studies and Research, Bill McLatchie, Assoc. Dean of Arts and Science, and David Dennis, Head of Biology.

The text of the Bonwill Tract dedication is contained on a following page of this report.

1986 saw a continuation of improvement in facilities at QUBS. Sumac Cottage was completed and ready for its first season of use. The Brown Lab was equipped with hot and cold and new dry well. The main labs of the Trilab were renovated and modernized in time for the summer research season. In fall, the rear overhang was closed in to add another working space to the Trilab, the old air compressor was rebuilt and installed to supply the aquarium. Also in fall, the lower boathouse was remodelled. A scuba-diver shower/change room was added, the floor of the upper lab braced with beams and areas for storage of boating equipment were enlarged and cleaned up. The hydro poles and lines to Earl Cottage were replaced and upgraded. Also, the remaining old hydro poles on the line to Curran Cottage were replaced. In winter, the White House was given a facelift with new paint, carpeting, tile and furniture. Both upstairs bathrooms were painted and a new tubsurround installed in the near bathroom.

QUBS now has an attractive identifying sign on the boathouse, and a new sign at the road, thanks to a suggestion by Mr. B.W. Burgess, and the cooperation of Principal Smith. The signs, designed by Peter Dorn of the graphics design unit of Queen's provide an attractive entrance to the station for visitors coming by either land or water.

QUBS made some major equipment gains in 1986. A new Zenith computer and printer were purchased. Coupled with the electronic weather monitoring system, acquired partly from Queen's Appeal and

Provincial Excellence Fund, NSERC operating funds per Dr. R.J. Robertson, the complete system should allow careful monitoring of many weather parameters. The system should be fully functional for the 1987 field season.

In fall, QUBS acquired a tractor with loader and snowblower. Recent purchases include a side mower and bush hog. This machine and accessories has made maintenance so much easier, one wonders how QUBS has survived so long without.

The tradition of holding an annual Open House continued in 1986. On July 6, station regulars hosted some 225 visitors touring the displays of research activities. The sixth edition of the community newsletter was distributed to most households in the area. This effort reaches those unable to attend the Open House. Favourable local response to these public relations efforts has been received. Many thanks to QUBS regulars for their investment of time and energy which is needed to ensure the success of these programs.

QUBS was busy throughout 1986 with a great diversity of visitors. Because of the International Ornithological Congress meetings in Ottawa and the International Congress on Bird Preservation meetings in Kingston, there were many international scientists who visited the field station (cf. Table 4). Both of these meetings had outings to QUBS as part of the program. Capitalizing on this, our Visiting Field Scientist Program enabled us to host a diversity of visiting scientists in 1986 (cf. Table 7), rather than our usual practice of one visiting scientist for a longer period. QUBS also hosted Dr. Jiro Kikkawa (Univ. of Queensland) under Queens-Australia Exchange Program per. Dr. Allen Keast (Queen's).

QUBS was the site of the Ontario Drosophila Meeting in August. The meeting, the second in a biennial series, was organized by Dr. Virginia Walker of the Biology Department at Queen's. Participants found QUBS, which they said reminded them of Asilomar in California (!), provided an excellent facility for their meetings.

Many thanks to the superb efforts of our kitchen staff, Nancy Davidson, Sharon Taylor and Linda Hughson. Early season maintenance projects were assisted by Morgan Hull and Sid Arnold. Anne Davies helped greatly with organizing the collections room. Late-season helpers were Linda Dupuis and Kevin Dufour. The spirit of cooperation among our regular staff, helpers and station users enables us to keep the quality of life at QUBS very high. Thanks to all.

Congratulations to Dr. David Philipp of the Illinois Natural History Survey and Julie Clausen on the occasion of their marriage on Jan. 1, 1987. Best wishes from all of us at QUBS.

DEDICATIONS OF BONWILL TRACT

The purpose of this ceremony is to dedicate this land, in which we stand, as the Bonwill Tract of the Queen's University Biological Station. This land, which is more than 1000 acres in extent, encompasses shorelines as we see here, woodlands, marshes, and meadows. This large area, with this diversity of habitat, will provide excellent opportunities for research and teaching in field biology for many decades to come.

The acquisition of this land by Queen's University was first suggested and then made possible by Mr. & Mrs. Bonwill. The Bonwills have operated Skycroft, a family campground promoting outdoor education and conservation, for almost 30 years. Because of their very strong commitment to conservation and education, and because they recognize the importance of preserving large areas for teaching and research in field biology, the Bonwill's wish to ensure that this land remains intact and that it continues to serve an important role in outdoor education and the development of understanding of plants and animals in their natural environment.

Since the objectives of QUBS are complementary to those of the Bonwills, the Bonwills initiated a transfer of this land to Queen's at a very reasonable price.

I would like to take this opportunity to thank the Bonwill's for their generosity and to express my admiration for their tremendous efforts and commitment to conservation and outdoor education.

Although the Bonwill's made this land available at a very modest price, in this period of financial stringency for Universities, it is difficult to come up with any extra money within the University Budget. For this reason, we asked the Nature Conservancy of Canada to contribute to the purchase of this property. They responded very generously.

Dr. Robertson's introduction was followed by a statement by Mr. Charles Sauriol of the Nature Conservancy of Canada, Dr. Dave Canvin, Dean of Graduate Studies and Research and Dr. Bill McLatchie, Associate Dean, Arts and Science, Dr. Wes Curran, the founding Director of QUBS was also introduced and acknowledged for his continuing contributions to QUBS.

NATURALISTS' WORKSHOP 1986

Since Dr. Adele Crowder was on sabbatical leave through the summer, Frank Phelan and Floyd Connor undertook to organize the Naturalists' Workshop Program. Despite Adele's conspicuous absence, the week-long program was held May 24-31.

Seventeen persons, several of them local permanent or seasonal residents, participated in the workshop. Three of the participants were old hands, having attended previous workshops. Other participants represented Parks Canada - Rideau Canal, Ministry of Natural Resources - Cochrane, Charleston Lake Provincial Park and the Prince Edward Region Conservation Authority.

Our visiting seminar leaders were Dr. Jim Pringle (Royal Botanical Gardens, Hamilton), Don Cuddy (MNR - Parks Branch, Kemptville), Dr. J. Michael Bristow, Dr. Francis Cook (National Museum of Natural Sciences, Ottawa), Dr. Mabel Corlett (Queen's, Geology), Jennifer Harker (M.M. Dillon Consultants, Toronto), T. Michael Harrison (Harrison Educational Consultants, Ottawa), Bryan Hughes, Dr. Don Rainnie (Health and Welfare, Bureau of Veterinary Drugs, Ottawa) and Kit Chubb (Avian Care and Research Foundation, Verona). The home team included Dr. J. Allen Keast, Jim Mountjoy, Dorothy Young, Dr. Adrian Forsyth, Dr. Raleigh Robertson, Frank Phelan and Floyd Connor.

The day-long road trip was to Frontenac Park. The Arab Gorge Trail provided an opportunity to look at ferns and their allies. This well-engineered trail, much of it a boardwalk, allowed close approach without disturbance. An afternoon session on topographic map reading was provided. After a steak barbecue dinner, we visited the Chubb's Avian Care and Research Foundation in Verona. This allowed close contact with a number of species, especially hawks and owls, which one is normally unable to gain in the field. We literally had to drag one of our members away. Right Naz?

Participants continue to comment favourably on the experience of the workshop. For 1987 plans include a larger segment on geology, an evening session on astronomy with Terence Dickinson and a day trip to the St. Lawrence Islands National Park.

A week-long workshop on Art and Nature with Dr. Bill Roff failed to meet the enrolment minimum and was cancelled.

Suggestions for topics for inclusion in the main workshop or other week-long or weekend workshops are welcome.

ABSTRACTS OF RESEARCH CONDUCTED AT QUBS 1986

I. RESEARCH BY QUEEN'S UNIVERSITY STUDENTS AND STAFF

DR. L. AARSEN

"Competitive Ability in Plants"

Gary Epp - "Manipulative Field Experiments on Competition in Plants From Two Different-aged Grassland Swards" - Ph.D. Thesis.

Field studies of competition in plants have been mostly of a descriptive nature. Only recently have more rigorous manipulative experiments been used to infer biotic interactions occurring in nature. The present study involves both descriptive and manipulative components. The descriptive component is comprised of surveys of a two-year old and a ten-year old grassland sward (in the Cemetery field). The manipulative component involves a species removal experiment, performed in 1986, and a nutrient supplementation experiment, to be done in 1987. Several combinations of dominant and sub-dominant species were removed from treatment plots in the two- and ten-year old swards. The response to removal of certain dominant species will give an indication of the importance of interactions between coexisting plant species. A third component of the manipulative experiment is a study of the effects of available area at the seedling stage on subsequent survivorship and productivity of the resulting adult plant. This was done by precisely mapping the location of seedlings emerging from 'mini-grasslands' sown with seed of several species collected from the two swards. The adult plants in these mini-plots were harvested at the end of the growing season (Oct.).

Douglas R. Taylor - "Transitivity and coexistence in three species of perennial grass" - M.Sc. Thesis.

The hayfields on the QUBS property near Lake Opinicon provide a convenient system for studying competition and coexistence in grassland plant communities. Current theory on species coexistence suggests that if species compete, they may coexist only if they are sufficiently differentiated in their niche requirements. Nevertheless, in these grasslands (more specifically, the East Field) we commonly find different species of grass growing less than an inch apart and apparently in severe competition with each other. In the summer of 1986 I surveyed the field to assess distributional relationships, and collected neighbouring clones to be used in glasshouse experiments to assess the relative competitive abilities of neighbouring genotypes.

Kimberly J. McKinley - "Neighbour effects in mast year seedlings of sugar maple *Acer saccharum* Marsh" - B.Sc. Thesis.

Why do some tree seedlings survive to become mature trees and others die? Trees frequently suffer high mortality at the seedling stage. Mortality is due in part to competition - there is simply not enough space for all the seedlings to grow. This will be especially

true for seedlings derived from mast seeding (the synchronous production of unusually large quantities of seed) and the intense competition resulting at the seedling stage may represent a major component of the process of natural selection affecting tree species. The Opinicon sugar maple population had a mast year of seed production in 1984. The purpose of this study was to search for evidence of the neighbour effects in the resulting seedlings two year later.

In the summer of 1986 surveys were conducted in a woodland site near the Darling farm along the Opinicon road. The size of the mast year seedlings was related to density, proximity to neighbours, soil variables, light availability and abundance of other species.

Theses:

Epp, G. 1986. Attributes of competitive ability and local coexistence in two different-aged hayfields. M.Sc. thesis. Dept. of Biology, Queen's University, Kingston, Ontario.

Taylor, D.R. 1986. Consequences of natural selection on patterns of phenotypic plasticity and genotypic variation in *Agropyron repens* (L.). B.Sc. Honours Thesis. Dept. of Biology, Queen's University, Kingston, Ontario.

DR. P.W. COLGAN

"Field Ethology of Fishes"

Jennifer Templeton - "Individual Differences in the Foraging Behaviour of Juvenile Rock Bass (*Ambloplites rupestris*)" - M.Sc. Thesis.

In the past, individual differences in various aspects of behaviour have been considered to be "deviations from optimal behavioural tactics" (as well as a statistical hassle). Recently, however, it has been suggested that such variation could result from adaptations which improve individual abilities to cope with the environment. These differences could be the result of genetics and/or experience.

My thesis is examining the influence of experience and learning on individual feeding behaviour in juvenile rock bass. Through chance encounters with a certain type of substrate, an individual could become better at detecting and capturing prey on one type than on another. That is, there should be an improvement in foraging efficiency with foraging experience. Theoretically, feeding preferences (such as where to feed and what prey to select) should change with changes in foraging efficiency, thus leading to feeding specializations in individuals within the same species.

I ran several lab experiments in which I varied substrate complexity and, therefore, the ease with which the benthic prey could be obtained. My subjects were yearling rock bass which had been collected as fry from the same nest, and which were naive with respect to live benthic prey and to substrate foraging. My general hypotheses are as follows: 1) The degree of preference an individual fish shows for a substrate type in a choice situation will be related to the individual's feeding efficiency on that substrate type 2) An

individual's feeding efficiency and, hence, preference can be altered according to experience.

Caroline Dunlop - "Effect of a Predator on Choice of Water Depth in Killifish" - M.Sc. Thesis.

An investigation was conducted to compare the effect of a predator (a Largemouth Bass, *Micropterus salmoides*) upon the swimming depth choice of two populations of Banded Killifish (*Fundulus diaphanus*). Killifish were collected from two populations: (1) Lake Opinicon (aquatic predators are present) and (2) Fish Lake (no aquatic predators). The experiments were conducted in the Aquarium House. Preferred swimming depth was determined in a vertical tank (54 cm X 35 cm X 130 cm; water depth 90 cm). There was a significant difference between the two populations (nested ANOVA, $r^2 = 0.64$, $p < 0.0001$). Lake Opinicon fish remained deeper in the water column. The effect of the presence of a predator was observed in a wading pool (diameter 2.3 m); the predator was put in a central enclosure. There were two conditions: (1) one water depth (30 cm), and (2) three depth zones (DEEP (30 cm), INTERMEDIATE (15 cm), and SHALLOW (2 cm)). These results are being analyzed.

Publications:

Brown, J.A. and P.W. Colgan. 1986. Individual and species recognition in centrarchid fishes: evidence and hypotheses. *Behav. Ecol. Sociobiol.* 19: 373-379.

Colgan, P.W., J.A. Brown and S.D. Orsatti. 1986. Role of diet and experience in the development of feeding behaviour in largemouth bass (*Micropterus salmoides*). *J. Fish Biol.* 28:161-170.

DR. R. HARMSSEN & DR. A. CROWDER

"Effects of Grazing on Succession in an Old-Field Community"

Co-Investigator: Bruce Henderson - M.Sc. student

This is a continuation of a long-term project initiated in 1975. In two old hayfields, 27 100m² research plots were permanently established in 1975. Every year, insect, rodent and plant populations are quantitatively sampled in all 27 plots, of which nine are screened with rodent-proof fencing and trapped empty once a year. In 1986 we continued to monitor closely the population of *Trirhabda* spp. (Goldenrod beetles) but most of our attention was focussed on an introduced grassfeeding caterpillar, *Thymelicus lineola* (the European Skipper). A series of caged experiments were carried out using this species.

Predation, parasitism and disease appear to be insignificant mortality pressures on the skipper which displays an erratic population density trajectory mainly due to climatic effects on overwintering eggs. At caterpillar densities above a certain threshold, the main host plant (*Phleum*) starts to suffer from grazing pressure to the point where other plant species display a growth response.

The outbreak of Gypsy Moth in the area, which became a possible

mortality pressure on tree seedlings in the plots in 1985, appeared to enter its decline phase in 1986 without causing any mortality.

A major new analysis of the effects of goldenrod dynamics on secondary goldenrod-specific grazers is being planned starting in 1987.

"Territoriality and Mating Success in the Dragonfly *Nannothemis bella*"

In 1986 we continued with our study of the Hebert Bog population of this small dragonfly. We concentrated on studying the quality of the territories throughout the season, expressing quality with such parameters as water depth, temperature, pH, surface area, amounts of shade, waterplants and disturbance and proximity of other territories. The extremely cold, wet weather caused high mortality so that the 1986 results cannot be considered representative. We intend to repeat the work in 1987.

Assistant: Patrick McGinn

Publications:

Crowder, A. and J.M. Bristow. 1986. Bibliography of wetlands in the Kingston Region. Blue Bill 33.

Crowder, A.A. and S.M. Macfie. 1986. Seasonal deposition of ferric hydroxide plaque on roots of wetland plants. *Can. J. Bot.* 64: 2120-2124.

Lee, R.C.P. and P. McGinn. 1986. Male territoriality and mating success in *Nannothemis bella* (Uhler) (Odonata: Libellulidae). *Can. J. Zool.* 64: 1820-1826.

Macfie, S.M. and A.A. Crowder. 1986. Soil factors influencing ferric hydroxide plaque formation on Roots of *Typha latifolia* L. Plant and Soil, in press.

Thesis:

Henderson, B. 1986. The European Skipper (*Thymelicus lineola*): Population ecology and herbivory in an old-field community. M.Sc. thesis, Queen's University Department of Biology.

DR. J.A. KEAST

I. "Fish Community Structure"

Research in 1986 continued ongoing the investigations of fish communities, focussing on specific aspects: planktivory and its significance to large, juvenile, and species that as adults are specialized planktivores; growth and stunting of fish in different communities and relationship of resource base to this; quantifying special features of the annual cycle of fish relative to cyclical seasonal availability of prey;

foraging in fish, and relationships of such features as handling time, visual acuity and prey detection distance relative to this; community structure and maximum size in contrasting lake systems (small pond, larger lake).

During the year, with the aid of summer assistants, work focussed on two major projects: (a) Space use and feeding of the mid-lake Lake Opinicon community of fishes (Alewife, Golden Shiner, Black Crappie, large Bluegill) and, (b) diets and growth relative to resource base in the Beaver Marsh fish community. Gill-net results and underwater observations showed both diurnal and seasonal shifts in abundance of the mid-lake fishes related to diurnal vertical migration in *Chaoborus* larvae and the dominant zooplankters. A major review paper is being developed on the subdivision of the zooplankton resource in Lake Opinicon between larval, juvenile, and inshore and mid-lake dwelling adult fishes. The Beaver Marsh study showed mid-summer food shortage and growth cessation in Killifish and Pumpkinseed Sunfish. A paper on planktivory was given at the Limnology meetings in New Zealand in February, 1987, and on Beaver Marsh fish community at the Wetlands meetings in South Carolina in March, 1986.

II. "Use of Time and Space in Passerine Birds".

The principal investigator has been following a study of use of time and space in major passerines in the vicinity of the field station; focussing on arrival and departure dates; song sequencing; insect population abundances (as measured by malaise trapping, caterpillar counts) and nestling times of major bird species. Attention is also given to subdivision of vertical space in foraging.

Work continued on diurnal and seasonal song sequencing in the bird community in the vicinity of the field station, with the latter being related to stage of breeding. Some bird species prove to sing mostly pre-dawn (Robin, Phoebe), others post-dawn and (sometimes) continuously all day (Red-eyed and Warbling Vireos). Some species have their major song period, in April - early May, others later, and there is considerable seasonal separation, and great variability in total length of the song season. In all, song is greatly reduced during the later part of the incubation and nestling period. Quantification of vertical feeding zonation in the common forest bird species continued as part of a longer-range study of division of time and space in the Field Station bird community.

Assistant: Krista Johansen.

Michael G. Fox - "Fish Community Ecology of Beaver Ponds" - Ph.D. Thesis

Beaver ponds are a significant wetland habitat in Ontario, and one which has received little attention in the literature from the perspective of fish ecology. I began a study of 3 beaver ponds near Lake Opinicon to examine the structure of their fish communities, and to answer 3 questions:

- (1) How does fish biomass and productivity in beaver ponds compare with that of the littoral zone of lakes?
- (2) Are beaver pond fish communities dominated by cyprinids and other small-bodied fish?
- (3) Is there some limitation on body size in beaver pond fish which allows larger fish (such as centrarchids) to exist only in stunted form? If so, what are the factors which create this condition?

Work in the summer of 1986 included physical surveys of the ponds; sampling of the fish using bag seines and gill nets; sampling of the food resource base using an Ekman dredge (benthos) and a Schindler trap (zooplankton); and measurements of temperature, pH and dissolved oxygen. Lower Dowsley Pond was sampled in May, July, August and September. Upper Poole and Perth Road Ponds were sampled in July, August and September.

The data suggest that beaver ponds which contain fish populations are dominated by cyprinids such as the Blackchin Shiner, Blacknose Shiner and Golden Shiner. Pumpkinseeds are also a dominant member of the community, numerically and by biomass. Small Largemouth Bass and Brown Bullheads were present in two of the ponds. The numbers of species present in each pond was 3, 9 and 10 in Lower Dowsley, Upper Poole and Perth Road Ponds, respectively. A fourth pond, Upper Dowsley, a phreatic pond 10 m in elevation above Lower Dowsley, contained no fish. I suspect this is due to its small size (1.3 ha) and the inability of fish to recolonize the pond following a catastrophic event (probably high temperature or deoxygenation).

Fish biomass in the beaver ponds appears to be comparable to that of the littoral zone of lakes, although it is tied up in large numbers of small-bodied fish. For example, mesotrophic Lake Opinicon supports an average biomass of about 7.3 g/m² in the Birch Bay littoral zone (Keast, unpublished data), while comparable figures for the 3 ponds are 25.7 (Lower Dowsley), 8.8 (Lower Poole) and 11.8 g/m² (Perth Road).

The Pumpkinseed population in Dowsley Pond grew faster than the populations of Opinicon and those of other nearby lakes, but were young (maximum age 4+). This was unexpected. Good Pumpkinseed growth could have occurred due to a combination of low initial densities, stable water conditions over the past 4 years, lack of competitors for macroinvertebrate resources, and lack of winter anoxic conditions. However, I predict that high levels of intraspecific competition will eventually result in Pumpkinseed stunting. Such conditions should be evident by next year.

Mary-Alice Blyth Snetsinger - "Growth and Diet in the Golden Shiner (*Notemigonus crysoleucas*)".

Growth and diet in the Golden Shiner was studied for the Cataraqui Conservation pond and in other larger water-bodies such as Lake Opinicon, with focus on how the prey resource base was divided up between the Shiner and other cohabiting species. A major objective is

to try to explain the existence of very large fish in some small ponds.

Publications:

Deacon, L.I. and A. Keast. Patterns of reproduction in two populations of pumpkinseed sunfish, Lepomis gibbosus, with differing food resources. *Envir. Biology Fishes*: 18, in press.

Hoyle, J.A. and A. Keast. The effect of prey morphology and size on handling time in a piscivore, the largemouth bass (Micropterus salmoides). *Can. J. Zool.* 65, in press.

Keast, A. Annual cycle and taxonomic composition of an Ontario deciduous forest bird community. *Proc. 19 Intern. Congress Ornithology, Ottawa*, in press.

Keast, A. Forest bird communities in historic and ecological perspective: a synthesis. *Proc. Intern. Congress Ornithology, Ottawa*, in press.

DR. R.D. MONTGOMERIE

"Sexual Selection and Territoriality"

Until 1986 my work at QUBS has been largely supplementary to research in the Canadian arctic. This year, however, the emphasis in my research program shifted to QUBS to complete work on damselflies begun in 1984 and to begin a planned long term study on the behavioural ecology of Robins.

"Sexual Selection and Territoriality in the Damselfly, Calopteryx maculata"

In 1986 Adrian Forsyth and I completed our third summer of studying a population of Calopteryx maculata that defends territories along the stream which flows into Telephone Bay at the west end of Lake Opinicon. As in previous years we individually marked all adult damselflies (with a number on the wings) as soon as they appeared on the stream so that we could follow the phenology and demography of this entire population. During July, we conducted controlled experiments on a section of the stream. By experimentally altering territory quality, we were able to examine the influence of territory quality on female choice and the intensity of male:female competition. For unknown reasons, few individuals emerged after the first week of July whereas emergence has peaked in mid-July in other years. As a consequence, we began preliminary work on a different population along the stream joining lower Rock and Pothole Lakes. Research in 1987 will probably focus on this larger but less accessible population.

Assistants: Julliane Nagy, Shannon Venance, Adele Mullie

"The Dawn Chorus of American Robins, Turdus migratorius"

I began work on robins at QUBS (and in Kingston) to try to answer some of the questions that came out of my work on the dawn chorus of high arctic birds. Most of the work in 1986 involved simply marking birds, delimiting territories and quantifying singing behaviour in preparation for some critical experiments to be conducted in 1987. In large part because of the ease of watching these birds from the porch at the lodge, Pat Weatherhead and I decided to embark on a collaborative project on several aspects of the behavioural ecology of this species. We expect this project to run for the next several years at QUBS and to involve a detailed analysis of territoriality, foraging behaviour, mate choice and parental care. We got started this past summer by marking most of the adult and second brood nestling population and setting up about 100 nesting platforms around the station.

Publications:

Forsyth, A.B. & R.D. Montgomerie. 1987. Alternative reproductive tactics in a territorial damselfly: sneaking by older males. *Behav. Ecol. Sociobiol.* in press.

DR. R.J. ROBERTSON

"Selective Forces and the Evolution of Breeding Strategies in Birds"

I. Behavioural Ecology of Tree Swallows.

A. Huddling behaviour: After finding several huddles of 15 or more birds in a box on cold mornings in April 1985, we systematically checked every box in Hughson's and Bridget's Grid at dawn every morning in early to mid April 1986. Although we occasionally found one or two birds that had spent the night in the box, we found no huddles, even though there were nights as cold as those that produced huddles in 1985. We conclude that huddling behaviour is not a routine part of the early spring behaviour of resident Tree Swallows, but is rather an opportunistic behaviour related to long periods of bad weather and involves birds that are migrating and/or have lower than average body weight.

B. Settling behaviour: We determined settling patterns directly by scanning each of the grids daily throughout April, and recording the number of birds on or near each box. We found that there is not a significant correlation between settling date, and either initiation of nest building or egg laying. Given the importance of determining settling date to the interpretation of nest site and/or mate choice, we conclude that, at least for Tree Swallows, it is important to determine settling date directly, rather than inferring it from first egg dates.

C. Polygyny: By placing "late" boxes on the 20 m posts at selected locations throughout the grid, we attempted to encourage polygynous matings. Although a number of males defended these late boxes along with their original box, few of them attracted second

females. This was in contrast to 1985, when numerous cases of double box defense resulted in bigamy. The low level of bigamy in 1986 may have been due to the rather cold and rainy season. This study will be repeated in 1987 in an attempt to evaluate the factors that favour bigamy and its effects on reproductive success of both males and females.

D. Subadult plumage: As a follow-up to her M.Sc. work on the adaptive significance of the brown subadult plumage of female Tree Swallows, Bridget conducted presentations of "brown" and "blue" models simultaneously. Males respond less aggressively to the brown model, suggesting that the subadult plumage may serve as a signal of sex. There was no strong evidence that female residents responded differently to the brown than to the blue model, indicating that the brown subadult plumage does not likely serve as a signal of subordination.

E. Infanticide: We conducted male removals at 10 nests, to create situations where replacement males might be expected to kill the offspring from the previous male if infanticide is part of the behavioural repertoire of Tree Swallows. We directly observed infanticide by two of the replacement males, and in one case, the male proceeded to nest at the site where he had killed the nestlings. We will continue studies on infanticide in 1987.

F. Competitive ability of subadults: We established a grid in the Northeast sanctuary in which we put up 6 boxes at a time, until the grid of 42 boxes was full, in order to determine whether subadult females are competitively inferior to adult females when they have equal access to nest sites. Our results were inconclusive, and this study will be repeated with a slightly different design in 1987.

G. Late season male investment: Preliminary observations indicated that males deserted nests late in the season, although during the peak of the season, males and females invest equally in feeding nestlings. By doing feeding watches of nests late in the season, we documented that in 1986, in contrast to less detailed observations in 1985, males continued to participate in feeding nestlings at the same level as females.

Research Assistant: Bridget Stutchbury

Field Assistants: Janet Cox and Anne Davies

II. Bluebird Breeding Biology

In anticipation of a cooperative study of the ability of female bluebirds to care for nestlings without male help, and of the role of the male in the maintenance of monogamy, to be done in 1987 with Dr. Patty Gowaty at Clemson, and Drs. Greg Ball and Al Dufty at the Rockefeller University Field Research Centre, we monitored the nesting success of approximately 25 pairs of Eastern Bluebirds in boxes in the swallow grids and along the back road.

Publications:

Leffelaar, D. and R.J. Robertson. 1986. Equality of feeding roles and the maintenance of monogamy in Tree Swallows. *Behavioral Ecology and Sociobiology* 18: 199-206.

Teather, K.L. and R.J. Robertson. 1986. Pairbonds and factors influencing the diversity of mating systems in Brown-headed Cowbirds. *Condor* 88: 63-69.

Robertson, R.J., H.L. Gibbs, and B.J. Stutchbury. 1986. Spitefulness, altruism, and the cost of aggression: evidence against superterritoriality in Tree Swallows. *Condor* 88: 104-105.

Muldal, A., J.D. Moffatt, and R.J. Robertson. 1986. Parental care of nestlings by male Red-winged Blackbirds (*Agelaius phoeniceus*). *Behavioral Ecology and Sociobiology* 19: 105-114.

Stutchbury, B.J. and R.J. Robertson. 1986. A simple trap for catching birds in nest boxes. *Journal of Field Ornithology* 57: 64-65.

Stutchbury, B.J. and R.J. Robertson. Behavioural tactics of subadult female floaters in the Tree Swallow. *Behavioral Ecology and Sociobiology*. In Press. (Accepted 17 November 1986).

Stutchbury, B.J. and R.J. Robertson. Do nest building and first egg dates reflect settlement patterns in the Tree Swallow? *Condor*. In press. (Accepted 9 June 1987).

Stutchbury, B.J. and R.J. Robertson. Two methods of sexing adult Tree Swallows before they begin breeding. *Journal of Field Ornithology*. In Press.

Stutchbury, B.J. and R.J. Robertson. Signaling subordinate and female status: two hypotheses for the adaptive significance of subadult plumage in female Tree Swallows. *Auk*. In press. (Accepted March 1987).

Michael Studd - "Alternative Strategies for Allocation of Reproductive Effort in Male Yellow Warblers". - Ph.D. Thesis.

Fieldwork for my thesis was completed this summer. The emphasis of this research has been on investigating the evolutionary significance and maintenance of the continuous variation in reproductive strategy, and the correlated plumage variation, in male Yellow Warblers (*Dendroica petechia*). By comparing the appearance and behaviour of banded males in different years, I have been able to demonstrate that the variation in plumage pattern and level of parental effort is not due to variation in male age. In addition, I found that variation in quality of territory occupied does not have any direct proximate influence on the behavioural variation. Hence, I have concluded that different male Yellow Warblers are using alternative and irreversible lifetime reproductive strategies.

Detailed analysis of time budgets and spatial use of territories has confirmed that the basis of this variation in strategy is a tradeoff in the allocation of limited reproductive effort to territorial effort and to parental effort. Those males expending high amounts of territorial effort, and low amounts of parental effort, gain access to territories which are of higher quality (as measured by two different indices of quality) than those occupied by more paternal males. The result of this is that nestling growth rates (an index of nest success) are on average equal across the entire range of males. Further analysis has shown that no advantage in any other measurable component of lifetime reproductive strategies in this population is evolutionarily stable.

Assistant: Anne Davies.

Publications:

Studd, M.V. and R.J. Robertson. 1985. Life span, competition, and delayed plumage maturation in male passerines: the breeding threshold hypothesis. *Am. Nat.* 126: 101-115.

Studd, M.V. and R.J. Robertson. 1985. Sexual selection and variation in reproductive strategy in male yellow warblers (*Dendroica petechia*). *Behav. Ecol. Sociobiol.* 17: 101-109.

Studd, M.V. and R.J. Robertson. 1985. Evidence for reliable badges of status in territorial yellow warblers (*Dendroica petechia*). *Anim. Behav.* 33: 1102-1113.

Sandy Connell - "Parental Care in Male Red-Winged Blackbirds (*Agelaius phoeniceus*)" - B.Sc. Thesis

The purpose of this study was to investigate differing patterns of parental investment by male Red-winged Blackbirds. The feeding of nestlings by male red-wings was previously thought to be rare and of little importance. However, recent studies show male care of nestlings has an important effect on female reproductive success in some populations (Muldal *et al.* 1986; Patterson 1979; Wallace 1985). Because selection by the female should be influenced by the extent that the male is disposed toward taking an active role in care and defense of the offspring, male parental care may play an important role in mate choice. Given this, and the role that studies of Red-winged Blackbirds have played in mating system theory, it is important to gain a better understanding of the factors which lead to an individual male's "decision" to assist at a particular nest.

To better define the male's parental role I wanted to document the effect of a human disturbance at the nest on the rate at which male and female blackbirds fed nestlings. To determine the extent to which contributions by the male influence reproductive success, I studied the ability of the male to single-handedly raise the nestlings from Day 8 (Day 1 = day of hatch) to fledging.

Patricia Hayes - "Behaviour of Replacement Male Eastern Kingbirds (*Tyrannus tyrannus*), and the Importance of Male Parental Care." - B.Sc. Thesis

In recent years there has been a great deal of interest in the possible adaptive nature of sexually selected infanticide in that it provides the infanticidal individual with increased breeding opportunities. In the summer of 1985, Dr. Raleigh Robertson initiated a study on sexually selected infanticide in tree swallows. My study was to expand his work to another species, the Eastern Kingbird, in the hope of better understanding the conditions under which infanticide may or may not occur in monogamous avian species. This was done by observing the behaviour of replacement males towards their new consorts.

A second objective of the study was to examine the ability of the female to cope without male help. In this way I could determine the importance of male parental care and obtain some insight into its role in the evolution and maintenance of monogamy.

Wallace B. Rendell - "Natural Populations of Tree Swallows (*Tachycineta bicolor*)" - B.Sc. thesis.

Since 1975, many aspects of Tree Swallow breeding biology have been analyzed at QUBS's New Land property, and also in the Northeast Sanctuary of Lake Opinicon. Tree Swallows are secondary hole-nesting birds; that is, they rely on birds such as woodpeckers to excavate nests which the swallows will use in subsequent years. However, at both sites nest boxes have been provided for the swallows to inhabit. Also, from year to year, these boxes have been spatially arranged, and/or arranged on a temporal basis to suit the study in progress. Intuitively, large swallow nesting areas don't typically show this organization and structure. Therefore, with the wealth of data accumulated from these artificial sites, how sure can we be that the results we receive, for studies such as swallow reproductive success and territoriality, are in fact representative of Tree Swallows breeding in their natural habitat?

In an attempt to draw similarities between the artificially nesting swallows and the natural swallows, I located two large study sites, Osprey Marsh near the New Land and Allan's Pond on Skycroft property, which contained many breeding pairs of Tree Swallows. By canoe, I began to collect observations on their nest dispersion, their nesting success, and who was breeding with whom, among other things. Interestingly, some differences have been found. For example, naturally breeding swallows appear to have a lower reproductive success than those swallows inhabiting the nest box grids.

In the summer of 1987, I will be continuing this study, with a third site included, to reassess and verify any differences that have been found.

Cathy Cameron - "Effects of parasitism by Protocalliphora sialia on Tree Swallow nestlings". B.Sc. Thesis.

Nestling Tree Swallows (Tachycineta bicolor) commonly host the ectoparasitic hematophagous larvae of Protocalliphora sialia. It was hypothesized that nestling growth would diminish (in terms of extent or rate) with increasing degree of larval infestation unless, in response to increased demand, parent Tree Swallows complement the energy lost to parasites by increasing the rate at which they feed their young. To test this hypothesis, parasites were, first of all, disproportionately redistributed among study nests in order to ensure a wide range in degree of parasite infestation. Nestling growth and feeding during the subsequent nestling period were assessed and compared. Within the experimental range of parasite loading, parasites did not appear to influence the growth of entire broods or of the individual nestlings within each brood. Absolute feeding rates were not significantly correlated with the intensity of parasitic infestation. However, relative feeding rates, which were expressed in relation to experimental modifications in parasite loading, provided promising results and revealed the need for further investigation.

Jessie Deslauriers - "Movement Patterns during Bird Migration"

In a preliminary analysis of banding data from Prince Edward Point, statistically significant differences between temporal movement during spring migration of selected passerine groups, as well as similarities between selected Parulid species and groups, was found. However, such data were subject to considerable "noise" - inconsistent mist net opening and closing times, bander preference in banding groups, etc. In addition, geographic restrictions at Prince Edward Point could influence migration movement. A preliminary four-day mist-net banding program with consistent handling and recording of birds was carried out between May 24 and May 27 at Opinicon to assess the probability of sufficient bird movement in the area to warrant a future banding program to serve as a "control" in further analysis of Prince Edward Point data. It is also hoped that observation of migrant foraging during the banding could help substantiate the preliminary hypothesis that movement patterns of migrant birds are frequently related to their habitat and foraging preferences.

II. RESEARCH BY NON-QUEEN'S STUDENTS AND STAFF

DR. A. FORSYTH AND DR. M. WOOD - Biosystematics Research Institute, Ottawa.

Female Publilia concava treehoppers lay egg masses on Eupatorium host plants. Females guard their egg mass by sitting astride the clutch and kicking away predatory mites and especially parasitoid mymarid wasps which attempt to oviposit in the treehopper eggs. Orphaning experiments show that this female parental care greatly increases hatch success. Some females do not guard their clutch but abandon it and move away to lay an additional clutch. The frequency of abandonment is greatest early in the breeding season when the

residual fecundity cost of parental care is highest. As the season progresses, females show an increasing propensity to guard their clutches. In some cases, females attempt to add eggs to the clutch of another female.

Females guarding eggs and nymphs are tended by ants when there is an ant colony in the vicinity of the host plant. Aggressive ants such as Camponotus greatly enhance nymphal survival. Exclusion experiments show that the presence or absence of ants also influences the tendency of females to desert their clutch. Females on plants without ants are two times more likely to abandon their eggs than females being tended by ants. I suggest that this reflects selection on females to reduced parental care investment in eggs and nymphs with a lower probability of survival than a clutch laid on an ant-tended plant. Experiments to test if abandoning females attempt to relocate and oviposit on plants close to ant colonies are in progress.

"Territory Tenure and Survivorship of Male Calopteryx Maculata Damselflies."

Calopteryx maculata damselflies have a resource defence polygyny mating system. Males defend floating vegetation where females mate and lay eggs. Territory defense costs and reproductive success are positively correlated and there is great variation in territory quality. In other words, males defending high quality territories have a high reproductive success but they expend great amounts of time and energy in territorial defense. By experimentally constructing paired territories of high and low quality we examined the relationship between tenure of a territory of known quality and male survival. If most males are of comparable quality, i.e. similarly able to defend a site and maintain themselves, then territory tenure and male survival should be reduced on high cost territories. However, males on high quality territories defended territories and lived longer than those defending low quality territories. I suggest that this results from variation in male quality with superior males occupying the best sites.

DR. JAMES FULLARD - Department of Zoology, Erindale College, University of Toronto, Mississauga, Ontario L5L 1C6

"Insect Neuroethology"

This summer marked the first full season of work using our intracellular neural recording and tracing set-up. We are studying the central nervous system (CNS) circuitry in moths that processes the echolocation signals of hunting insectivorous bats and controls the moth's resultant defensive behaviour. In particular, this summer was spent examining the neuro-musculature of the sound-producing structure (tymbal) in two species of arctiid moths, Halysidota tessellaris and Pyrrharctia isabella. This structure is used by some arctiids to emit sounds at echolocating, attacking, bats that act in some way to cause the bat to break off its pursuit. We are using this stereo-typed response as a neuroethological model of sensory processing and defensive behaviour. Also, since the moth activates each of its

paired tymbals in an alternating fashion, this reflex constitutes a rhythmic behaviour. Using the stain, Lucifer yellow, Jayne Yack has identified six motoneurons within the tymbal nerve branch (IIIN2a) of a variety of arctiids and we have labelled the largest of these cells as the putative tymbal motoneuron (TymbMN). We are now intracellularly searching for this neuron in specimens of the Dogbane Tiger Moth (*Cycnia tenera*), raised at QUBS, at our laboratories in Toronto. We hope to eventually identify the entire CNS circuitry responsible for expressing this behaviour and test our neural model for explaining its rhythmicity and multi-sensory input.

Assistants: Jayne Yack, Tracey Burton

Jayne Yack - "Mechanoreceptive Origins of Insect Ears" - M.Sc. Thesis

This year was geared towards the continuation of two neuroethological projects related to moth auditory systems. The first was an investigation into the evolution of insect auditory organs. Nerve cells of the tympanic organs (ears) in auditive moths were compared to homologous cells in deaf moths using histological and neurophysiological techniques. The data from these experiments support the suggestion that insect auditory receptors evolved from proprioceptive sensory organs monitoring body movements.

The second project was an attempt to gain insight into the neurological circuitry underlying a defense behaviour against bats in arctiid moths. Certain species will produce ultrasonic clicks when exposed to the echolocation cries of insectivorous bats, serving to either startle the bat or to jam its echolocation signal. This year marked the discovery of certain nerve cells associated with the sound-producing muscles, adding yet another link to the chain in our understanding of the circuitry of acoustically driven sound production.

I would like to thank Tracy Burton for her assistance as 'Moth Mama' this year, resulting in the rearing of approximately 90 bouncing baby moth pupae.

DR. M.R. GROSS - Department of Biological Sciences, Simon Fraser University, Burnaby, British Columbia.

"Evolutionary Ecology of Fish Reproduction"

We are conducting research on: (i) mating system evolution, (ii) parental care evolution, and (iii) alternative life history evolution, in fishes. Much of the work on alternative life histories is now done in collaboration with Dr. David Philipp and his group from the Illinois Natural History Survey. This year we focussed on obtaining additional electrophoretic data on the fertilization success of cuckolded sunfish. Ron Coleman also spent his third summer at Opinicon and Julee Greenough joined the crew for her B.Sc. thesis.

Ron Coleman - "Evolution of Parental Investment" - Ph.D. Thesis

Ron completed several projects concerned with the evolution of parental investment in species with solitary male parental care. These included determination of the energetic cost of parental investment using fat analysis; the consequences of experience with predators on parental investment. In addition to this work on Bluegill Sunfish, he gathered the final data for a study of Black Crappie reproduction, and worked on two theoretical papers; a resolution of the Concorde fallacy, and a resolution of the anadromy/catadromy paradox of fish migrations. This research wouldn't have been possible without the hard work of his assistant, Lisa Venier.

Julee Greenough - "Male Parental Investment and the Evolution of Female Choice" - B.Sc. thesis

Julee tested her model of the influence of parental investment on female choice by Bluegill Sunfish. Her work suggests that since both large broods and broods with a high degree of relatedness are most valuable to a male providing parental care, then females will (i) prefer to spawn with males whose nests already contain eggs, and (ii) avoid males who have been heavily cuckolded.

DR. D.P. PHILIPP - Aquatic Biology Section, Illinois Natural History Survey, Champaign, Illinois.

"Bluegill Reproduction Studies"

Our group at the Illinois Natural History Survey is collaborating with Dr. Mart Gross and his research team at Simon Fraser University to study a number of aspects of Bluegill Sunfish reproduction. The bulk of our studies center on assessing the genetic, physiological and environmental factors which may influence alternative reproductive behaviours among male Bluegill. In addition, we are studying molecular and behavioural aspects of the interspecific hybridization which occurs between Bluegill and Pumpkinseed in Lake Opinicon.

Assistants: Karyn Cepek, Blake Konkle

Pawel Kindler - "Hormonal Analysis of Male Bluegill during the Spawning Season"

Pawel has developed the radioimmune assay (RIA) techniques to quantify testosterone levels in the sera of male Bluegill. Using this technique, Pawel has determined the pattern of testosterone production among male Bluegills throughout the annual cycle.

He has also studied how testosterone levels change during the spawning season in detail. In addition, by determining the differences in testosterone levels among parental males from different areas within a Bluegill colony, he is assessing the relationship between hormone production, aggression and reproductive success. He is also assessing the role which testosterone plays in determining which life history, parental or cuckolded, male Bluegills assume.

Julie Claussen - "The Dynamics of Colony Formation and the Reproductive Effort of a Bluegill Population".

1986 was the second year of this study. Last year we tracked the spawning activity of all colonies formed in a five bay study area for the duration of the spawning season. To determine if parental males routinely respawn during a season, males were marked and recaptured. This year we monitored how many of these males returned to the study area to spawn. We also assessed how reproductive success varies spatially among nests on different areas within a colony, among colonies from different areas of the study site and temporally among the different individual spawning bouts during the season.

DR. BRUCE P. SMITH - Dept. of Biology, University of New Brunswick.

"Water Mite Parasitism of Aquatic Insects"

During 1986 I continued research on water mites of the genus Arrenurus. Intensive collecting of adult mites was conducted, and females were maintained in the laboratory to obtain eggs, and subsequently, larvae. Approximately 35 species have been collected and identified, including several new species, and the females and larvae have been associated with males (past descriptions of these species had been based only on males). Intensive collections of emergent insects at Deadlock Bay were also conducted, which will provide a detailed quantitative record of host utilization, and spatial and temporal relationships within this host/parasite community. Progress was also made on characterizing the tanypodine chironomid fauna of Lake Opinicon, and the association of females with males (again, species descriptions had only been based on males). The findings of this year will result in a number of publications on the systematics of Arrenurus mites and tanypodine midges, and the ecological data will form the foundation for my planned studies into host selection and the impact of parasitism by mites on chironomid communities.

Assistants: Wanda Cook, Lori Laughland

Publication:

Smith, B.P. and S.B. McIver. 1984. Factors influencing host selection and successful parasitism of Aedes spp. mosquitoes by Arrenurus spp. mites. Can. J. Zool. 62: 1114-1120.

Smith, B.P. 1986. New Species of Eylais (Acari: Hydrachnellae; Eylaidae) parasitic on water boatmen (Insecta: Hemiptera; Corixidae) and a key to North American larvae of the subgenus Syneylais. Can. J. Zool., 64(10): 2363-2369.

Wanda Cook - "A Comparative Study of Reproductive Strategy among Species of Arrenurus" - Honours Thesis, Dept. of Zoology, University of Guelph (supervisor - R. Brooks)

During the Arrenurus mite-rearing program mentioned above, clutch

size and the size of larvae and females were recorded in order to compare the expenditure of reproductive effort among some 30 species. Reproductive strategy will be related to host associations and taxonomic affinity. Preliminary observations show that the Arrenurus (Arrenurus superior) group (parasites of dragonflies and damselflies) are by far the largest mites as adults, and produce very large clutches of among the smallest larvae encountered (the "r selection" end of the spectrum). Arrenurus (Micruracarus) spp. (parasites of chironomids) are medium to small mites as adults, and produce small clutches of the largest larvae encountered (the "K selection" end of the spectrum). Arrenurus (Megaluracarus) manubriator has probably the smallest clutches, and largest larvae relative to adult size; the larva of this species forgoes the parasitic phase, transforming to a nymph soon after hatching, without ever feeding.

Patricia Ramsay - "The Ultrastructure of Mermithid Nematodes Parasitic on Midges (Diptera: Chironomidae; Chironominae)" - Honours Thesis, Dept. of Biology, University of New Brunswick (Supervisor - Dr. B. MacKinnon).

During spring and early summer of 1986, adult midges parasitized by mermithids were collected at blacklights and live specimens were sent back to U.N.B. for study. Nematodes obtained from these chironomids were used for morphological studies.

DR. P. WEATHERHEAD - Department of Biology, Carleton University, Ottawa.

"Red-winged Blackbird Reproductive Strategies"

The study initiated last year to investigate several aspects of Red-winged Blackbird breeding was continued in 1986. An attempt was made to colour band all breeding adults in the New Land marshes and to monitor their reproductive success. Blood was collected from all banded adults and all nestlings for eventual use in DNA "fingerprinting" to study paternity/cuckoldry patterns. This work will continue in 1987.

Assistants: Drew Hoysak, Kevin Dufour, Linda "Crash" Dupuis.

"Ecology and Behaviour of Black Rat Snakes"

No specific studies were undertaken with this project in 1986, but the long term monitoring of the population by marking and measuring all Black Rat Snakes encountered near the field station was continued.

Assistants: Tracey Burton, Drew Hoysak, nearly everyone.

"Age and Dominance in Brown-headed Cowbirds"

This study, initiated in 1985, is intended to determine whether older male cowbirds are dominant to yearlings in competition for food

in an aviary. Age-related dominance is usual in most birds and yet, in the field, young male cowbirds appear as successful as adults in being able to pair with females. Our results indicate that the usual age-related dominance occurs in the aviary, leaving the mating system observation unexplained.

Assistants: Tracey Burton, Shannon Venance.

Kit Muma - "Sexual Selection in Female Red-winged Blackbirds" - M.Sc. Thesis

Female Red-winged Blackbirds are often aggressive toward new females attempting to settle in the same territory. Females also exhibit varying degrees of colouration of their epaulets, the same feathers that appear bright red in males. This study is attempting to determine whether variable plumage colouration in females is associated with female-female competition for males or is due only to incomplete suppression of an autosomal male trait. Research will continue in 1987.

Assistants: Chris Eckert, Shannon Venance.

Publications:

Eckert, C.G. and P.J. Weatherhead. Male characteristics, parental quality and the study of mate choice in red-winged blackbirds. Behavioural Ecology and Sociobiology, in press.

Eckert, C.G. and P.J. Weatherhead. Owners, floaters and competitive asymmetries in territorial red-winged blackbirds. Animal Behaviour, in press.

Eckert, C.G. and P.J. Weatherhead. Ideal dominance distributions: a test using red-winged blackbirds. Behavioural Ecology and Sociobiology, in press.

Eckert, C.G. and P.J. Weatherhead. The correlation between male quality and territory quality in red-winged blackbirds. Behavioural Ecology and Sociobiology, in press.

Montgomerie, R.D. and P.J. Weatherhead. Risks and rewards of nest defence in birds. Quarterly Review of Biology, in press.

Weatherhead, P.J. 1986. How unusual are unusual events? American Naturalist. 128: 150-154.

Weatherhead, P.J. Field tests of information transfer in communally roosting birds. Animal Behaviour, in press.

Weatherhead, P.J. and K.A. Boak. 1986. Site infidelity in song sparrows. Animal Behaviour. 34: 1299-1310.

Weatherhead, P.J., Clark, R.G. and H. Greenwood. Natural selection and sexual selection on body size in red-winged blackbirds. Evolution, in press.

David A. Wiedenfeld - "Ecomorphology of Sedentary and Migratory Populations of Yellow Warbler, Dendroica petechia" - Ph.D. Thesis - Department of Biological Science, Florida State University, Tallahassee, Florida.

QUBS served as the first North American field site for my study on foraging behaviour/morphological interrelationships in the Yellow Warbler, Dendroica petechia. In the overall study I will compare temperate-breeding and tropical-breeding populations of the warbler, examining the foraging behaviour at several sites in North America and in Central America, and comparing patterns in foraging with patterns in morphological characters.

I collected data on about 35 adult male Yellow Warblers, primarily at sites along Lindsay Lake Road, at SRB, on the Lodge grounds, and at Cow Island marsh. I netted and colour-banded eleven of the males at Lindsay Lake Road, but different individuals show no consistent differences in their foraging. I also located the warblers' nests so I could determine whether the parent's foraging behaviour changed when it began feeding nestlings, but there seems to be no differences. A high proportion of the warblers' diet is glabrous, green caterpillars; they do not seem to eat the abundant, hairy or spiny, black Gypsy-Moth caterpillars.

The Yellow Warblers at QUBS capture 58% of their prey by perch-gleaning, 34% by hover-gleaning, and 5% directly from the air in the manner of flycatchers. Almost all (93%) of their prey is captured from within 1/3 m of the birds. They are able to catch prey quickly, capturing a second prey item within 20 s of the first 71% of the time. They are usually found in the upper levels of trees, spending 62% of the time in the top 1/4 of the vegetation. They prefer low trees; their median foraging height above ground is 3 3/4 m.

Table 1: Summary of course credits in the Ontario Universities Program in Field Biology earned at Queen's University Biological Station in 1986.

Module Topic	Professor and Affiliation	Dates	Credit/ Student	Queen's	Carleton	York	Brock	Western	Waterloo	U of T	Total Students/ Module	Total 1/2 course Credits
Bird Territoriality	Weatherhead (Carleton)	May 11-17	1/4	5	1	1	1	1	0	1	10	5
Fish Ecology	Keast (Queen's)	May 18-24	1/4	1	1	3	0	2	0	0	7	3.5
Songbirds	Ratcliffe (Queen's)	May 18-24	1/4	4	0	1	1	3	0	1	10	5
Lakes and Streams	Dickman (Brock)	Aug 24-30	1/4	2	0	2	1	1	0	0	6	3
Bats and Caves	Fenton (Yorkleton)	Aug 24-30	1/4	3	1	0	0	2	0	4	10	5
Wetland	Crowder (Queen's)	Aug 24-30	1/4	2	0	4	0	1	0	1	8	4
Small Mammals	Boag (Queen's)	Aug 31-Sept 6	1/4	4	0	1	1	1	0	5	12	6
Total Number of Student - Weeks	-	-	-	21	3	12	4	11	0	12	63	-
Half Course Credits	-	-	-	10.5	1.5	6	2	5.5	0	6	-	31.5

Table 2: Summary of course credits in the Ontario Universities Program in Field Biology earned at locations other than OUS in 1986.

Module Topic	Professor and Affiliation	Dates	Location	Credit/Student	Queen's	Carleton	York	Brock	Western	Waterloo	U of T	Total Students/Module	Total 1/2 course Credits
American Southwest	Handford (Western)	May 1-22	Arizona	1/2	3	2	1	0	6	0	2	14	14
Tropical Marine Ecology	Duthie, Hynes (Waterloo)	May 2-16	West Indies	1/2	4	1	1	1	2	6	1	16	16
Field Ornithology	Rising, Parsons (Toronto)	July 7-19	Churchill	1/2	2	1	1	1	2	2	5	14	14
Natural History	Licht (York)	Aug 3-9	Algonquin Park	1/4	1	1	2	2	0	0	0	6	3
Terrestrial and Fresh Water	Falls (Toronto)	Aug 22-Sept. 6	Dorset	1/2	1	0	2	1	2	0	4	10	10
Alpine Ecology	Millar (Western)	Aug 23-Sept 6	Kananaskis	1/2	2	1	1	0	5	0	3	12	12
Experimental Marine Biology	Owen (Western)	Aug 22-Sept 7	Huntsman	1/2	6	3	1	0	5	0	0	15	15
Terrestrial and Aquatic	Hawthorn, Smith (Waterloo)	Aug 30-Sept 12	Algonquin Park	1/2	2	0	0	1	1	14	0	18	18
Marine Biology	Carter, Taylor (Waterloo)	Aug 30-Sept 14	Huntsman	1/2	3	0	0	1	0	3	0	7	7

Total Number of Student - Weeks

Half-Course Equivalents

-	-	-	-	-	47	17	16	12	50	46	30	218	-
-	-	-	-	-	23.5	8.5	8	6	25	23	15	-	114

Table 3: Overall Summary of the Ontario Universities Program in Field Biology for 1986

	Queen's	Carleton	York	Brock	Western	Waterloo	Toronto	Total Student Weeks in Modules	Total Half Course Credits
Total Student-Weeks not at QUBS	47	17	16	12	50	46	30	218	109
Total Student-Weeks at QUBS	21	3	12	4	11	0	12	63	31.5
Total Student-Weeks in Field Modules	68	20	28	16	61	46	42	281	.
Total Half-Course Equivalents in Field Modules	34	10	14	8	30.5	23	21	.	140.5

4. Summary of Research Use at Queen's University Biological Station - 1986.

Project Supervisor Affiliation	Project Title	Students and Affiliation	Residency
J. Aarssen (Queen's)	Competitive Ability in Plants		Occasional
	Competition in Grassland Plants	Gary Epp (Queen's)	Occasional
	Transitivity and Coexistence in Grasses	Doug Taylor (Queen's)	Occasional
	Neighbour Effects in Sugar Maple Seedlings	Kimberly McKinley (Queen's)	Occasional
D.W. Colgan	Field Ethology of Fishes		Occasional
	Foraging Behaviour of Rock Bass	Jennifer Templeton (Queen's)	May 24-Aug 25
	Predator effects on Killifish Behaviour	Caroline Dunlop (Queen's)	May 14-Sept 2
A. Crowder and D. Harmsen	Effects of Grazing on Old Field Succession		Occasional Occasional
	Population Ecology and Herbivory of Skippers	Bruce Henderson (Queen's)	Occasional
	Territoriality of the Little Bog Dragonfly	Patrick McGinn (Queen's)	Occasional
J.A. Keast (Queen's)	Community Ecology of Fish		Apr 26-Sept 2
	Fish Community Ecology of Beaver Ponds	Michael Fox (Queen's)	Occasional
		Ed St. Dennis (Queen's)	Occasional
		R. Ansari (Queen's)	Occasional

		Francois Chapleau (Queen's)	Occasional
D. Montgomerie (n's)	Sexual Selection and Territoriality		May 3-Aug 17
	Sexual Selection and Territoriality in Black Damselflies	Adele Mullie (Queen's)	July 10-Aug 20
		Shannon Venance (Queen's)	June 15-Aug 13
		Julliana Nagy (Poland)	July 1-Sept 6
J. Robertson (n's)	Breeding Strategies in Birds		May 1-Aug 31
	Behavioural Ecology of Tree Swallows	Bridget Stutchbury (Queen's)	May 1-Sept 1
		Janet Cox (Queen's)	May 1-July 31
		Anne Davies (Queen's)	May 1-June 30
	Allocation of Reproductive Effort in Yellow Warblers	Mike Studd (Queen's)	May 5-June 10
	Blowfly Parasitism of Tree Swallow Nests	Cathy Cameron (Queen's)	May 6-Aug 14
	Movement Patterns during Bird Migration	Jessie Deslauriers (Queen's)	May 24-27
	Parental Care in Male Red-winged Blackbirds	Sandy Connell (Queen's)	May 1-July 31
	Natural Populations of Tree Swallows	Wally Rendell (Queen's)	May 1-Aug 7
	Behaviour of Replacement Male Eastern Kingbirds	Trish Hayes (Queen's)	May 5-Aug 14

A. Forsyth and I. Wood (Biosys- ics Research Institute)	Territoriality in Male Black Damselflies		Occasional Occasional
	Egg Guarding in Treehoppers	David Bell	June 19-Aug 9
I. Fullard (Erindale - U of T)	Insect Neuroethology		May 15-Aug 16
		Tracey Burton (Carleton)	Aug 1-31
	Mechanoreceptive Origins of Insect Ears	Jayne Yack (Erindale)	May 15-Aug 25
A.R. Gross (Simon Fraser)	Evolutionary Ecology of Fish Reproduction		June 16-30
	Evolution of Parental Investment	Ron Coleman (Simon Fraser)	May 14-July 17
		Lisa Venier (Queen's)	May 14-July 14
	Male Parental Investment and Female Choice	Julee Greenough (Simon Fraser)	May 14-July 16
D.P. Philipp (Illinois Natural History Survey)	Genetic Aspects of Bluegill Reproduction		May 30-July 31
	Colony Formation and Reproductive Effort of Bluegill	Julie Claussen (INHS)	May 29-July 31
		Karyn Cepek (U. of Illinois)	May 29-July 31
	Hormonal Analysis of Male Bluegill	Pawel Kindler (INHS)	June 1-July 18
		Blake Konkle (INHS)	May 30-July 31
		Lorne Wolfe (U. of Illinois)	Occasional

		John Epifanio (IHNS)	Occasional
P. Smith	Water Mite Parasitism of Aquatic Insects		Apr 25-Aug 24
		Lori Laughland (U. of New Brunswick)	Apr 25-Aug 24
	Reproductive Strategies of Water Mites	Wanda Cook (Guelph)	Apr 27-Aug 22
Vander Kloet (ia)	Demography of <u>Pinus rigida</u> and <u>Vaccinium corymbosum</u>		Occasional
J. Weatherhead	Redwinged Blackbird Reproductive Strategies		May 2-July 22
		Kevin Dufour (Carleton)	May 2-July 31
		Linda Dupuis (Carleton)	May 2-July 31
	Ecology and Behaviour of Black Rat Snakes	Drew Hoysak (Carleton)	March 21-Aug 18
		Tracey Burton (Carleton)	May 2-July 31
	Age and Dominance in Brown-headed Cowbirds	Shannon Venance (Queen's)	May 20-June 15
	Sexual Selection in Female Red-winged Blackbirds	Kit Muma (Carleton)	Apr 2-July 31
		Chris Eckert (Carleton)	Apr 1-May 15 and occasional
Wiedenfeld (ida State U.)	Ecomorphology of the Yellow Warbler		May 31-June 22

Others Visitors to QUBS - 1986

Dr. Don Rainnie
Jane Watson
Michelle Venance
Robin Whittall
Roman Romaniuk
Valerie Palda
Peter Franchi
Sara Claussen
Monty Jearings
Ron Ydenberg (Simon Fraser)
Luc Giraldeau
Dr. George Williams (SUNY)
Dr. Ed Crossman
Dr. Craig Sargent
Andrew Mason
Mark Williamson (Queen's)
Linda Hamilton (Queen's)
Lynn Brodsky (Queen's)
Wende Gregory
Lynn & Bryan Hughes
Karen Best
Don & Mona Phelan
Roberta Fulthorpe
T. Michael Harrison & Family
Andrew Hurly (Queen's)
Kevin Teather (Carleton)
Jim Complak
Myron Smith
Jim Hoyle
Kim Stutchbury
Andre Deslauriers
Barb Martin
Dr. David Layzell (Queen's)
Jenny Bothwell (U. of Illinois)
Hui Lee
Natalia Doolan
Vytenis Gotceitas (Queen's)
G. Gauld
Ron and Sue Vinkle
R. Syme
R. Manninen
Katherine Duff
Dr. J. Kikkawa (U. of Queensland, Australia)
Dr. Pekka Helle (U. of Jyväskylä, Finland)
Dr. H. Recher (Australia Museum, Sydney)
Mike Eliasziw
Doris Audet
Dr. Audrzej Dyrz (U. of Wroctow, Poland)
Dr. Jeremy Greenwood (U. of Dundee)
Dr. Przemyslaw Busse (U. of Golaniski, Poland)
Jim Mountjoy (Queen's)
David Shotler
Michael Leslie

Mr. and Mrs. A. Dupuis
Jennifer Harker (M.M. Dillon)
Mr. and Mrs. J. Taylor
Michael Connell
Marilyn Chow
Sheila Macfie (Queen's)
Dr. John Spence (U. of Alberta)
S. Canscaden
Mr. and Mrs. Lewis
Frank Poce
April Gowing
Gayle Grant
Mr. and Mrs. A. Davidson
Dr. R. Fraser (Queen's)
Dr. D. Dennis (Queen's)
Christine Hanssens
Richard Popowich
Alastair Mathers (MNR)
Dave Mowbray (CBC)
Dr. and Mrs. W. MacLatchie (Queen's)
Dick Bowman (Queen's Gazette)
Dr. and Mrs. D. Canvin (Queen's)
Allan and Ellen Bonwill
Jim and Anne Barton
Dr. B. Smallman (Queen's)
Dr. and Mrs. H.M. Good (Queen's)
Peter Dorn (Queen's Graphics)
Dr. Amotz Zahavi (Tel. Aviv. Univ., Israel)
Dr. Torbjorn Fagerstrom (Lund U., Sweden)
Dr. Rauno Alatalo (U. of Jyväskylä, Finland)
Dr. Lars Gustafsson (U. of Jyväskylä, Finland)
Ruth Mace (Oxford)
Tomas Park (U. of Uppsala, Sweden)
Dag Ershman (U. of Uppsala, Sweden)
Juan Moreno (U. of Uppsala, Sweden)
Bodil Enoksson (U. of Uppsala, Sweden)
Dr. Lee Cass (UBC)
Dr. Arni Lundberg (U. of Uppsala, Sweden)
Sir Charles and Lady Fleming (New Zealand)
Colin Catterall (Australia)
Dr. M. Petric (U.K.)
Fred Lohrer
Dr. and Mrs. K.C. Kwon (Korea)
Jorg Bohner (W. Germany)
Ian McAllan (Australia)
Julian Ford
Jari Konki (Finland)
Paul Matzner
Volker Haas (W. Germany)
Urs Glutz von Blotzheim (Switzerland)
Juha Tianinen (Finland)
Dr. Walther Thiede (Germany)
Janet Hinshaw
Dr. Lew Oring (U. of N. Dakota)
Helmut Sternberg (West Germany)

Glenn Hall
Elissa Landre
Peter Evans (UK)
Tanya Hall
Ronald O'Neal (UK)
Paul Tatner (Scotland)
Ben Rawdon (S. Africa)
Kay Ball
Molly Neill (New Zealand)
M. Adret-Hansberger (France)
Charles Collins
Eleanor MacLean
Stephen Ambrose (Australia)
Richard Jordan (Australia)
Jane Bradley (UK)
Chr. Scherzuiger (Germany)
Wolfgang Evi (Germany)
Volker Laske (Germany)
Carel Ten Cake (Netherlands)
Peter Grieg-Smith (UK)
Alan Burger
Dr. Gary Bell (Boston University)
Joanne Morgan (Queen's)
Rob Capell
Rob Alvo
Doug Menard
Barb Hilder
Bill and Debbie Nowell
H. Lisle Gibbs (U. of Michigan)
Dr. J. Toohey
David Galbraith (U. of Guelph)

Table 5: Documentation of Research Use for 1986

	User Days			
	Supervisor	Graduate Student	Assistant	Total
of Toronto:				
Barrett	0	0	2	2
Fullard	60	86	56	202
Collins	2	0	0	2
	<u>62</u>	<u>86</u>	<u>58</u>	<u>206</u>
leton:				
Weatherhead	52	121	465	638
on Fraser:				
Gross	16	68	128	212
inois Natural tory Survey:				
Philipp	68	112	147	327
of New Brunswick:				
Smith	109	0	240	349
adia:				
Vander Kloet	2	0	0	2
orida State:				
Wiedenfeld	0	23	0	23
osystematics Research stitute:				
Wood	1	0	45	46
of Guelph:				
Galbraith	0	4	0	4
otal External	310	414	1083	1807

Supervisor	Graduate Student	Assistant	Total
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ernal

en's

Aarssen	0	104	0	104
Colgan	0	198	0	198
Harmsen	0	1	1	2
Keast	99	39	9	147
Montgomerie	75	3	155	233
Robertson	153	37	710	900
Crowder	2	1	0	3
Johansen	3	0	0	3

al Internal	332	383	875	1590
al External	310	414	1083	1807
nd Total	642	797	1958	3397
Queen's	52	48	45	47
External	48	52	55	53

er-Days in Teaching Activities 1474

scellaneous User-Days (visitors, families of researchers, field trip participants) 1267

tal User Days 6138

art-time and full-time support staff are excluded from above figures).

e 6: Summary of Conference, Meeting and Field Trip Use of Queen's University
Biological Station - 1986.

Organizers	Function	No. of Participants	Duration
Ila Macfie (Queen's)	Bio 300 (Ecology) Weekend	16	Jan 10-12
Lifer Templeton (Queen's)	Station Reunion	20	Jan 17-19
Peter Boag (Queen's)	Bio 439 (Population Ecology) Weekend	22	Jan 31-Feb 2
Pamela Stokes (of Toronto)	Shield Lakes Acidification Network Telegraph Workshop	51	Apr 11-13
William Reeve (Queen's)	German Language Immersion Field Camp	17	Apr 26-May 4
h Johnson	Science Teacher's Workshop	11	May 2
R.J. Robertson (Queen's)	International Ornithological Congress Excursion	10	June 18-22
Allen Keast (Queen's)	International Congress for Bird Preservation Field Trip	20	June 18
R.J. Robertson (Queen's)	International Ornithological Congress Field Trip	40	June 26
Virginia Walker (Queen's)	Drosophila Conference	16	Aug 8-10
ter Hall	Ottawa Field Naturalists	60	Aug 10
J. Smol (Queen's)	Bio 335 (Limnology)	55	Sept 20-21
Ila Macfie (Queen's)	Bio 202 (Ecology) Weekend	102	Oct 4-5
M. Harrison (York U.)	Eastern Ontario Science Educators Council Workshop	34	Oct 18
ger Lupton (Harbot Lake H.S.)	Limnology Field Trip	12	Oct 24
Ila Macfie (Queen's)	Bio 202 (Ecology)	38	Oct 26

e 7: Queen's University Biological Station Seminar Schedule 1986

May	Natalia Doolan QUBS Alum.	"Canada World Youth in Thailand"
May	Julee Greenough Simon Fraser Univ.	"Female mate choice in Bluegills"
May	Dr. Sarah Lenington Institute of Animal Behaviour Rutgers University	"Factors controlling the frequency of deleterious genes in wild house mouse populations"
Jun	David Wiedenfeld Florida State Univ.	"Comparative foraging behaviour of Yellow Warblers"
Jun	QUBS Regulars	"Research Summaries for IOC Workshop"
Jun	Dr. Adrian Forsyth	"Birds of Monteverde and the need for conservation of habitat for vertical migrants"
	Dr. Jim Dickson U.S. Forest Service	"Research programs of the SE Experiment Station"
Jun	Dr. Jim Dickson State of Texas Turkey Calling Champion	"Field demonstration and discussion of the function of turkey vocalizations"
Jun	Dr. James Fullard Univ. of Toronto	"Neuroethology: behaviour from the inside out"

st International Ornithological Congress visiting lecturers.

***** Visiting Field Scientist *****

Jun	Dr. Arni Lundberg Univ. of Upsalla Sweden	"Polyterritoriality, mate choice, and mating system of the Pied Flycatcher"
Jun	Dr. Harry Recher Australian Museum Sydney, Australia	"Foraging ecology of Australian thornbills"

***** Opinicon - Australia Exchange Visitor *****

Jul	Dr. Jiro Kikkawa Univ. of Queensland Brisbane, Australia	"A study of silvereyes (Zosterops): morphology, behaviour, ecology, and evolution"
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***** Visiting Field Scientist *****

Jul	Dr. Andrez Dyrce	"Polygyny in the Great Reed Warbler"
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Univ. of Wroclow
Poland

Dr. Pekka Hella
Univ. of Jyvaskla
Finland

"Bird communities in forestry harvest
areas of Northern Finland"

***** Visiting Field Scientist *****

1 Dr. Jeremy Greenwood
Univ. of Dundee
Scotland

"Frequency Dependent Selection by
Predators"

***** Visiting Field Scientist *****

11 Dr. Przemyslaw Busse
Univ. of Gdansk
Poland

"Bird migration studies in Poland"

ul Kit Muma
Carleton Univ.

"Violent femmes (Redwings)"

ul Dr. Bruce Smith
Univ. New Brunswick

"Aggregative patterns of mite
distribution within host
populations"

Jul Blake Konkle
Univ. Toronto

"Predicting Littoral Fish Food
Resources"

Jul Cathy Cameron
Queen's Univ.

"The effect of Protocalliphora sialis
maggots on growth and parental care
of Tree Swallows"

Jul Jayne Yack

"The evolution of insect auditory
systems"

Jul Sandy Connell

"Paternal care in Redwings: why was
it considered unimportant?"

Trish Hayes

"Division of labour in Eastern
Kingbirds"

Jul Wally Rendell

"Real Tree Swallows; Ha!"

Bridget Stutchbury

"Settling patterns in Tree Swallows"

Aug Dr. Rachel D. Robertson
Dept. of Leisure Studies
Arizona State Univ.

"Interpretation and the Natural
Sciences: A Conceptual Framework"

) Aug Jennifer Templeton
Queen's Univ.

"Individual differences in foraging
behaviour in juvenile rockbass; the
role of experience and learning"

e 8. Fee Schedule for 1987.

Accommodation - Room and Board

- \$240/mo - includes obligation for chores on a rotating schedule
- \$355/mo - no obligation for chores
- \$125/wk - including weekend, eg. Field Courses (includes a lab fee)
- \$17/day - 24 hr room and board (incl. meals & overnight, no chores)
- \$3.00 - breakfast only
- \$3.00 - lunch only
- \$6.00 - dinner only
- \$7.25 - overnight accommodation - academic purposes - no food
- \$11.25 - overnight accommodation - nonacademic purpose - no food

Accommodation Surcharges (applied as additional % to above charges)

<u>Surcharge</u>	<u>Accommodation type</u>
0%	White House (Dormitory), Curran Cottage (multi)
5%	Cabins 1 - 7, 9, 10, 12 and Shaker
10%	Cabins 8 (if solo), 11 and White House apartment
15%	Keast, Earl, and Sumac Cottages

Boat Rental

- \$125/mo, \$57/wk - includes maintenance on boats and motors
- gas and oil not included in rental fee

Bench Fees

- \$3.65/day - Non-Queen's staff or major researcher (M.Sc., Ph.D. candidate, project coordinator or Post-doctoral Fellow)
- \$1.25/day - each non-Queen's assistant

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