INTRODUCTION

Nineteen eighty-four was a year of high activity in virtually all aspects of the program at Queen's University Biological Station. In research, an average of 35 professors, graduate students, honours students and assistants were in residence through the summer. Abstracts of the research projects and personnel involved are contained in the following pages, and are summarized in Table 4. Productivity of research at QUBS is documented in the updated list of theses and publications included in this report. (The publication lists with research abstracts are not complete for all projects). In teaching, QUBS hosted 9 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 Table 1. The Naturalists Workshop, another integral part of the QUBS teaching program, was again very successful with an enrollment of 19. It is described on the following pages. QUBS also provides an extremely important facility for a variety of field trips for several fall and winter term courses (cf. Table 5). In many cases, especially for the 110+ students in General Ecology, this first exposure to field work is a key element in stimulating interest in field biology.

Nineteen eighty-four was also an extremely active year in terms of facility improvement at QUBS. With a combination of funding from Queen's ($25,000), the Biology Department ($10,000), and QUBS ($10,000), a new 6.1 x 15.2 m two storey building was erected to provide additional laboratory, classroom, and collection room space. The lower story is a single large laboratory which provides solid bench space for microscope work for up to 24 students, or which is divisible into 3 separate bays for field season research projects. The lab will provide much needed facilities for projects involving electrophoresis, physiological or other analytical work requiring precision instrumentation. The upper storey is divided into a seminar room, a collections room to house the moth and plant collections, a computer room, and a work area with dry bench-space. Frank and Floyd have built lab furniture for both upper and lower levels this winter, so the lab will be fully functional in 1985. By moving seminars to this new lab building, the present library will provide improved desk space for data transcription and library work.

A new aquarium building was completed in late summer 1984 to house equipment awarded by NSERC to Drs. Keast, Colgan, Collins, Gross and Johansen. Funding for the construction of the building was provided by the Biology Department ($6,000), QUBS Trust Fund ($10,000), and the School of Graduate Studies and Research ($4,000). The building is divided into two experimental rooms and one holding room. Ten 500 l and ten 250 l fiberglass tanks were built by D.S. Yacht Sales of Odessa. All tanks will have flow-through well and/or lake water, and accurate temperature regulation capability.

Another major construction project involved completing the second half of upgrading the hydro line from the main line into the station. The old poles and wire were replaced with new poles and #2 wire to expand the capacity and improve the reliability of our hydro service.
This project involved extensive tree cutting and trimming to allow the new line to be set back from the road. Funding for this project was provided by Physical Plant ($2500) and the QUBS Trust ($1,000). Major electrical renovation was also completed on the station grounds, where new underground service was provided to the new lab and aquarium, as well as to the trilab, boathouse, white house, lodge, and manager's house. A pad mount transformer enabled elimination of all above-ground wires past the workshop. The Vice-Principal Services provided $9000 funding for this project.

Other construction projects at QUBS in 1984 involved landscaping and construction of a stone wall along the driveway, necessitated by the underground wiring. Frank and Floyd made further progress on the workshop by completing an open driveshed on the south side of the building. Although the workshop is a much needed facility, it is being constructed entirely with QUBS funding and labour, which requires that its completion be phased in over a relatively long period of time. An aviary and boardwalk were also constructed in 1984 as part of an Environment 2000 project which is described later in this report.

QUBS was once again involved in the local community through the publication of the 4th Edition of the Community Newsletter. We also held an Open House on 8th July which was attended by approximately 400 local residents and cottagers. The Open House was followed by the Departmental Picnic which was once again a very enjoyable event.

The most valuable resource at QUBS is its people. A high level of participation by the "regulars" produced an excellent seminar series which is described in Table 6. Once again, the "regulars" made important contributions to cost effectiveness of the Station by cooperating in dish duty and other chores. The entire Station owes a sincere "thank you" to our 1984 cooks, Ann Armstrong and Ruth Wescott, who provided the essential nutrition and morale boosting goodies. The Station is also indebted to Floyd Connor who took over as assistant manager when Dave Warren resigned in May. Floyd contributed generously to station upkeep and with assistance in many projects. Morgan Hull provided much needed aid as an early season volunteer to help Frank get ready for the beginning of the busy field season.

We are grateful to Marg Phelan for the cover sketch of the dinner bell.
WORKSHOP ON ENVIRONMENTAL INVENTORY AND PLANNING

In October, a workshop on environmental inventory and planning in the Kingston area was held at Queen’s University Biological Station at Lake Opinicon, organized by the Fowler Herbarium.

The workshop brought together naturalists (amateur and professional), environmentalists, consultants, personnel from governmental agencies including Ontario Ministry of Natural Resources and Ontario Ministry of the Environment, and Parks Canada, from the National Museum and Royal Ontario Museum, and regional planners. Fifty registrants attended.

Examples of present inventories that were described in detail included the Rare Plant Survey, the Atlas of Breeding Birds, and herpetile surveys. Intensity of sampling, scale, and adequacy of inventory were discussed. Local planners suggested that the level of inventory is above that which can be used in local planning, because of public attitudes; on the other hand, it is inadequate to meet precise queries such as those arising from the siting of hydro lines. Cooperation, co-ordination, the ownership, and the accessibility and the confidentiality of various data bases were major themes during the second half of the day.

The participants valued the interchanges of fact and opinion and especially the opportunity to meet. There will be another informal workshop next fall.
Environment 2000 Project

Dr. R. J. Robertson and Frank Phelan

Environment Canada initiated the Environment 2000 program to provide employment for unemployed persons, especially those between 16 and 24 years of age. The program is a conservation program to extend and accelerate activities which contribute to the conservation, preservation and restoration of the natural environment.

Our interest in this program was sparked by intense concern in the vicinity of Lake Opinicon about the present and future status of the bass fishery in the area. As a result, we drafted a proposal to study bass spawning habitat in several local lakes, to evaluate the role of existing fish sanctuaries, and assess the impact of aquatic plant growth on fish spawning. In addition, a second project on the status of the Black Rat Snake was proposed. We hoped to locate further hibernacula and to add to knowledge of movements, etc. of past studies. A third project was also suggested to evaluate the breeding habitats of the rare Henslow’s Sparrow.

As luck would have it, we received approval of the three projects late in the season. Bass spawning was finished, and the nesting season of Henslow’s sparrow was well advanced. As a result, the bass project and Henslow’s sparrow project were dropped. Funds were reallocated, and the Black Rat Snake project and two new projects were initiated which would enhance the ability of the field station to serve as a research centre and to provide public education and University education of natural history.

In July, four employees began 20 weeks of work on the three projects. A new aviary was soon completed. This facility will greatly enhance our ability to study wild birds in captivity. The design allows individual holding, varying arena sizes or a full-size flight cage. At least one research project will make extensive use of the aviary in 1985.

A larger-scale construction project was completed in the fall. A boardwalk traversing Cow Island marsh from the mainland to the island itself was built. The boardwalk will allow close observation of marsh organisms for research and teaching, while minimizing the impact of human traffic on the marsh. Already several groups have made use of the boardwalk. It will be an asset in many future research and teaching projects.

Project employees: Drew Hoysak, Jayne Yack, Rob Capell and Andy McClure.
Dr. Adele Crowder organized and coordinated the Sixth Naturalist's Workshop which was held at QUBS from June 2 to 9, 1984. The Workshop, designed to provide interpretive skills for parks and ministry personnel as well as amateur naturalists, was once again found to be highly rewarding for all participants.

The workshop attracted 19 participants in its sixth instar. Those leading sections included Dr. Van Zyll de Jong from the National Museum in Ottawa, Dr. J. Pringle from Hamilton, Dr. M. Bristow and Dr. D. Moffatt. The Queen's contingent included Dorothy Young, with Melanie Gouzoulis and Peter Billingsley; Allen Keast and his helpers, Sheila Macfie, Tim Conlin, Jean Gagnon and Louise St. Cyr. Alex Mills and his team pursued elusive whippoorwills, while continuity was provided by Frank Phelan, Floyd Connor, and Adele Crowder.

Two new features were introduced: Dr. Mabel Corlett gave an introductory talk on the local geology, which was much appreciated, and an all-day trip was designed to include limestone habitats as well as the local shield types. At Frontenac Provincial Park the group used and criticized the newly written guide to the Arab Gorge Trail, led by Anne Robertson of the Kingston Field Naturalists and John Immerseel of O.M.N.R. Dr. Pringle's expertise on ferns was much in demand in the gorge. The diversity of salamanders in the Little Cataraqui Valley was shown by Mary Alice Blyth and Diane Lawrence at Cataraqui Region Conservation Authority's land near Glenburnie. Limestone alvar topography and its rare plants such as Geum triflorum were investigated at Camden East and the final stop was at Hebert Bog, an example of an intermediate fen, with damsel flies and insectivorous plants.

The workshop attracted its usual stimulating mixture of people and was described by Alan Campeau, of the Ministry of Natural Resources, as "the most fulfilling and appropriate course I have ever taken in my ten years as a Ministry employee". He pointed out that the different backgrounds from which people came contributed to the interest.
ABSTRACTS OF RESEARCH CONDUCTED AT QUBS 1984

I. RESEARCH BY QUEEN'S UNIVERSITY STUDENTS AND STAFF

DR. L. AARSESEN


The importance of competitive ability of plants and its role in structuring plant communities has gone largely unstudied. My present study is designed to quantify the competitive abilities of several pasture plants and relate this to the patterns of local coexistence in two different aged swards at Opinicon. This will involve 1) greenhouse (Earl Hall, QU) and field-plot (New Barn field) experiments to measure competitive abilities, ii) a field survey (Cemetery field) of coexistence patterns, and iii) a species removal experiment (Cemetery field). The balance of these three parts will hopefully provide information on how relative competitive abilities of coexisting species differ depending on community age, and test the hypothesis that coexistence is permitted through a balancing of competitive abilities for contested resources as a consequence of interspecific competition.

In 1984, two 100m x 30m. grids were constructed in the Cemetery field: one represents the pasture that was originally sown in the spring of 1974; the other, the pasture which was sown in the spring of 1984. Seed was also collected from 15 species in both swards for subsequent germination experiments. In the New Barn field, a plot of 20m x 20m. was ploughed for field-plot experiments to be performed in 1985.

DR. P. W. COLGAN

"Field Ethology of Fishes"

During this season, Dr. Joe Brown and I continued our experiments on male choice by female Pumpkinseed Sunfish (Lepomis gibbosus) presented with males who were or were not infested with metacercarial parasites. This work will continue next season.

QUBS was the source of fish for the work on schooling in Blunt-nose Minnows (Pimaphales notatus) by Joanne Morgan (M.Sc. student) and on habitat selection by young centrarchids by Vytenis Gotceitas (Ph.D. student) on campus.

The research on the behavioural toxicology of young bass subjected to PCP doses also continued (see report by Dr. P. H. Johansen).

Studies were initiated on the behavioural ecology and mating systems of darters (genus *Etheostoma*).


Through the Summer Career-Access Program, Jennifer conducted research on the role of experience in the ontogeny of feeding behaviour of young rock bass (*Ambloplites rupestris*).

Publications:


**DR. R. HARMSEN**

"Effects of grazing on succession in an old-field community".

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 controls, nine are sprayed with pesticides to avoid insect grazing, and nine are screened with rodent-proof fencing and trapped empty once a year.

In 1984 we concentrated our research on two outbreak insects, the European skipper which feeds on grasses and the goldenrod beetle which defoliates goldenrod. The skipper population was intensively studied, although it is not in outbreak, while the beetle population is merely being monitored as it is reaching peak density of its second outbreak in ten years. Standard monitoring of the community by sampling the insect populations, and by vegetation analysis, was continued as well.

Co-investigator: Dr. A. Crowder
Assistant: Bruce Henderson (M.Sc. student)

Publications:

McBrien, H. L. and Harmsen, R. Growth response of goldenrod (*Solidago canadensis* L.) to periodic defoliation. Accepted for
Rupert Lee - (Post-Doctoral Fellow) "Territoriality in Nannothemis bella (Odonata)"

Nannothemis bella is a small dragonfly that breeds abundantly in Hebert Bog. A preliminary project performed by Barb Hilder in 1982 showed that males defend small territories (c. 0.5m$^2$), to which females come to mate and lay eggs. A male might hold a territory for several days, or even a week or two. In addition, many males are non-territorial. In the present project, further observations were taken, with the following questions in mind:

1. Do non-territorial males obtain mates?

2. For how high a proportion of its adult life does a male hold a territory, and how much does this vary?

3. Are non-territoriality, intermittent territoriality, and long-term territoriality separate strategies, or do they form a continuum?

4. If a territorial male does not obtain mates, does he leave his territory and search for another?

5. Is there a correlation between the rate at which a male obtains mates and the amount of aggressive activity he has to perform in order to keep his territory?

The techniques used were: 1. Colour-code marking of as many individuals as possible on the day of their emergence, and subsequent daily or twice-daily censusing of marked individuals, recording the time and place of observation; 2. Observation of individual territory-holders, recording numbers of fights with other males, numbers of copulations, and durations of territory-holding. Analysis of data is continuing. Apparently only territorial males obtain mates and, for most of the breeding season, there is not enough suitable territory space for all the males to hold territories simultaneously. Non-territorial males are therefore probably searching for territories rather than for mates.

DR. P. H. JOHANSEN

"The Effects of Pentachlorophenol (PCP) on the Physiology and Behaviour of Young-of-the-Year Largemouth Bass (Micropterus salmoides)"

This summer, we continued and extended investigations into PCP effects on the development of feeding behaviour in young bass. We also investigated the dose-related effects of PCP on the food conversion efficiency (growth) of young bass in both long-term and short-term experiments.
Publications:

Mathers, R. A., J. A. Brown and P. H. Johansen. The growth and feeding behaviour responses of largemouth bass (Micropterus salmoides) exposed to PCP. *Aquatic Toxicology (In Press).*


DR. J. A. KEAST

"Community Ecology of Fish"


Work was carried out on the annual cycle of the bluegill (*Lepomis macrochirus*), focussing on seasonal patterns of energy allocation. The fish emerge from the winter with energy stores depleted. With the warming of the temperatures the fish commenced feeding; calorific value of the tissues increases sharply; linear growth occurs and, in late summer, excess energy is allocated to fat storage for the coming winter. The study involved documenting growth patterns simultaneously with detailed underwater observations on feeding, and the carrying out of body fat and tissue calorific value determinations. Built into the study were a series of projections as to body energy depletion through the winter.


Data processing was continued on the comparative study of feeding and growth in pumpkinseed sunfish (*Lepomis gibbosus*) in Upper and Lower Beverley Lakes. Differential growth rates were linked to environmental quality including deficiencies in molluscs, the major food of mid-sized fish. An accessory study was carried out on breeding habitats and habitat quality.

"Planktivory in Lake Opinicon"

Work continued on planktivorous fishes and planktivory in Lake Opinicon, prey selection and the way in which planktivore resource is subdivided, prey switching when zooplankton are low, and the energetic implications of switching to alternative resources at these times. Separate studies were made of a littoral zone association of planktivores and zooplankton, the community consisting mainly of small-bodied and juvenile fishes, and a mid-lake association, where the fish species are large bodies.

As part of the latter, a detailed study was made of vertical
space utilization, and diurnal and seasonal shifts in distributions of the fish and their prey.

Publications:


DR. R. D. MONTGOMERIE and LORNE WOLFE

"Pollination Ecology"

In May and June 1984, we looked at some of the patterns and reproductive consequences of floral variation in Hepatica acutiloba. This plant is in a family (Ranunculaceae) that is well-known for variable floral structure but, in the past, this variation has mainly been considered a nuisance to (systematic) botanists. We tested hypotheses directed toward answering two questions: (1) is there a tradeoff in allocation to reproductive tissue? and (2) how does floral variation influence reproductive success? We obtained some answers but, of course, came up with even more questions which we will try to address in the spring of 1985.

Publications:


DR. R. D. MONTGOMERIE and DR. A. FORSYTH

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

We began this project in June 1984 to examine the feasibility of
conducting an intensive study of Calopteryx maculata, a small (and
beautiful!) damselfly which occurs commonly on a few streams in the
vicinity of Lake Opinicon. During the summer we individually marked
and followed the fates of all individuals (700) that emerged along a
2 km section of stream at the west end of Lake Opinicon. This yielded
some useful information on territory establishment and tenure and on
the survivorship of males and females. We also conducted experiments
to test a simple model of optimal territory size, and gathered some
interesting data on alternative mating tactics of males.

This seems to be an excellent study species for addressing
several questions about territoriality, mate guarding and the
reproductive tactics of both males and females. In 1985, we will join
forces with Dr. John Alcock (Arizona State University) to continue
work begun in 1984.

Publications:

Forsyth, A. and R. D. Montgomery. Geriatric reproductive

Montgomery, R. D. and A. Forsyth. Optimal territory quality:
the tradeoff between mating and chasing. In preparation.

DR. R. J. ROBERTSON

"Selective forces and the evolution of breeding strategies in birds"

In 1984, our studies on tree swallows which have been underway
since 1976, focussed on the question of the adaptive significance of
the unique pattern of subadult plumage in first year females. Bridget
Stutchbury conducted her second field season on this study. Mike
Studd, who completed his M.Sc., is now in a Ph.D. program, and will
continue his work on Yellow Warbler parental behaviour in relation to
plumage pattern. Our work on Redwings, with the help of Caroline
Wallace, compared the extent of male feeding of nestlings in relation
to habitat. A new project on bluebirds was initiated in 1984 with the
help of Katie Mackay.

Publications:

Blancher, P. J. and R. J. Robertson. In press. A comparison of
Eastern Kingbird breeding biology in lakeshore and upland habitat.

Blancher, P. J. and R. J. Robertson. In press. Site consistency
in kingbird breeding performance: implications for site fidelity.

blackbirds limit harem size? I. A removal experiment. Auk 102:
205-209.

and female competition for breeding opportunities in the Tree Swallow.
Wilson Bull.

Preferred nest spacing of an obligate cavity-nesting bird, the Tree
Swallow, Tachycineta bicolor. Condor.


I am continuing my research on the adaptive significance of subadult plumage in female tree swallows (Tachycineta bicolor). There are approximately 30 species of North American passerines in which the male has a delay in plumage maturation, but the tree swallow is the only NA passerine in which young females have a distinct subadult plumage. I am investigating the possibility that this plumage serves a status signalling function. A large proportion of subadult females are excluded from breeding due to a limitation of nest sites, and presumably adopt an opportunistic tactic to obtain nest sites. I am quantifying patterns in agonistic behaviour between intruders and residents, and conducting model presentation experiments to examine the relationship between plumage colour and aggressive behaviour.

Assistant: Andy McClure

Publication:


For my Ph.D. thesis, I am expanding my study of behavioural and plumage variation in male yellow warblers (Dendroica petechia). Previous research for my M.Sc. thesis, using the same study populations, revealed that there was a positive correlation between the degree of development of the sexually distinctive male plumage and certain indices of aggressive and territorial response. There was also a negative correlation between degree of plumage development and level of male parental investment. In my current field work, I am concentrating on investigating further the various time budget, energetic, and life-historic consequences of the alternative reproductive strategies that I have proposed to account for the selective maintenance of this behavioural and plumage variation. To examine the hypothesis that different males are using different reproductive strategies, detailed time budgets for individual males were collected throughout the 1984 breeding season. These data will be used to assess whether there is an energetic tradeoff between investment of reproductive effort in obtaining and maintaining high quality territories and investment of effort in parental care.

Assistant: Darlene Parsons
Publications:


Katie Mackay - "Adoption, indifference, or infanticide in replacement male Eastern Bluebirds (Sialia sialis), and how females cope without male help". B. Sc. thesis.

The focus of my study was to test for the occurrence of infanticide by replacing male Eastern Bluebirds. I also considered if and how lone females are able to compensate for the lack of male help in raising a brood. I removed breeding males early in the nestling stage, and monitored the reaction of the replacement male to the offspring of the previous male. I compared nests where there were indifferent replacement males, or no replacement males, to those where replacements were parental or the original male was present. This was done to assess the differences in several variables of reproductive success of assisted versus unassisted females. In addition, I monitored the weight of unassisted females in comparison with paired females over the nestling stage to determine any detrimental effects on the females which lacked male help during the nestling stage.


The purpose of this study was to evaluate the occurrence and extent of male parental care, and male feeding of nestlings in the Red-winged Blackbird. It is hoped that this would provide additional information to determine whether male care of the young might be an important factor influencing female mate choice in polygynous species. The study was conducted in Cow Island Marsh and various upland sites in the vicinity of Forfar. Nest watches were conducted and growth measurements of the nestlings were collected throughout the nestling period. Male feeding of nestlings was observed to occur frequently in the uplands as well as the marsh.

DR. JOHN SMOL

"Algae and Invertebrates of Lake Opinicon".

During 1984, sporadic algal and invertebrate collections were taken from Lake Opinicon. These are of considerable interest because the lake supports such high chrysophyte populations. The resting stage (stagespore) formation is of particular interest.
Publications:


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

DR. N. C. COLLINS – Dept. of Zoology, Erindale College of University of Toronto.

"Effects of Social Interactions on Growth of Bluegills"

The overall aim of my research is to elucidate the conditions limiting the growths of benthivorous fishes in lakes, in the hope that some of these conditions might eventually be managed to increase production. In 1984, I conducted two replicates of a field experiment to determine whether reductions in Lepomis density would increase their growth rates. Duration of the manipulations was only 7 days, so that predation-related changes in the benthic resource available could be minimized. Growth rate assessments are being made using daily growth rings in otoliths, which allow comparison of pre- and post-manipulation growth for each experiment completed. Although we have not finished measurements on the otoliths of experimental fish, we have succeeded in establishing for bluegills that daily growth rings are accurate growth indicators for age 2-3 fish.

In a series of wading pool experiments last year, I studied patterns of bluegill growth when pools of 3 and 6 fish were supplied with 4% daily rations of food distributed from defendable patches. I deliberately maximized the chances of social interactions in these experiments because I had hoped no density effect would appear, allowing me to eliminate social interactions as a mechanism for any density effect observed in the field experiments. In low density pools, large and small fish grew equally well. At high densities, all sizes grew slower than at low densities, but small fish were affected more severely than large ones. We are presently analysing videotape records of the interactions around feeding sites to determine the mechanisms for these effects. The significant density effect has prompted me to continue the wading pool experiments in 1985, using increasingly more natural conditions.

Assistant: Steve Runowski and Jules Rickards

BLAKE KONKLE – Dept. of Zoology, Erindale College, University of Toronto.

"Artificial substrates as indicators of food limitation in sunfishes (Cenrarchidae)" – M.Sc. thesis.

Littoral areas of lakes with dense macrophyte growth are
typically high in secondary productivity and provide both a large potential food base and a refuge to fishes. However, conventional methods of estimating benthic standing crop in such areas are generally inefficient, labour-intensive in both collection and processing of samples, and therefore costly. In addition, current methods fail to measure those components of the benthos most relevant to fish. The purpose of this project is to evaluate an alternative method for estimating benthic standing crop, using artificial substrates which can be deployed from a boat (eliminating the need for specialized skills like SCUBA) and selectively sample those prey types which are more likely to be eaten. Prey activity was also monitored using specialized traps suspended above the bottom during light and dark periods. Gut contents of year II and III bluegills and pumpkinseeds were obtained concurrently by pulsed evacuation and some fish were also retained for analysis of daily growth rings in otoliths. Catches on the substrates and in traps, expressed as biomass in taxonomic or particle-size categories, are now being processed in order to predict both food intake and short term growth rates of fish.

Assistant: Julian Rickards

DR. M. B. FENTON - Dept. of Biology, Carleton University, Ottawa


Assistants: Cay Weir, Rob Capell

DR. JAMES H. FULLARD - Dept. of Zoology, Erindale College, University of Toronto

"Neuroethology of Moths"

In preparation for the establishment of a permanent summer neurophysiological laboratory to study the sensory ecology of moths and insectivorous bats, this summer was devoted towards a preliminary investigation of the following questions:

First, the potential evolutionary pathway towards the development of both an ear and its associated peripheral neural network was studied in three species of noctuid moths which possess these sensory structures and two species of saturniid moths which do not. One hypothesis which has been postulated regarding the evolution of insect ears is that they are derived from cuticular stretch or tension mechanoreceptors. Since exoskeletal receptors are widely distributed over the insect body, the tuning of such an organ into a device sensitive to low energy, high frequency acoustic radiation (i.e. echolocation signals of bats) seems reasonable. A variety of peripheral nerves servicing the wing bases of inauditive (deaf) moths (areas near the auditory organ in auditive moths) were electrophysiologically examined to determine if they contained neurons responsive
to acoustic stimulation. The thoracic nerve trunk, IIIN2 in the saturniid, Automeris io, revealed a limited response to intense, low frequency sounds (2 - 5 kHz, 80-100 dB SPL), suggesting a possible physiological substantiation of the cuticular mechanoreceptor hypothesis of auditory organs for these insects.

Second, I examined the peripheral neural response of the auditory organ of the noctuid, Xylena curvimagula, to a series of two-tone acoustic stimuli simulating the output of a bat's echolocation signal masked against a noisy environment (e.g. high frequency chorus of orthopteran katydids). Preliminary studies suggest that the two-neuron peripheral network characteristic of noctuid moths serves the insect by allowing it a backup in situations where its nervous system is saturated by high levels of ambient acoustic activity. Whereas this moth's most sensitive auditory neuron, the A1 cell, appears to become completely adapted to continuous stimulation, its second cell, the less sensitive A2, maintains its ability to code for the pulsed sounds characteristically emitted by an echolocating bat. This ability suggests a mechanism for discerning the approach of a bat even when masked by normal background acoustic noise.

Finally, in addition to these electrophysiological studies, Caren Furlonger was responsible for a series of neuroanatomical examinations of central nervous systems connecting the auditory groans of a variety of local Tiger moths (Arctiidae) to their sound-producing structures (tymbals). These dissections will be used in conjunction with laboratory studies of the CNS network responsible for sound production in the Dogbane tiger moth, Cycnia tenera.

Assistant: Caren Furlonger

Publications:


DR. M. R. GROSS - Dept. of Biological Sciences, Simon Fraser University.

"Evolutionary Ecology of Fish Reproduction"

We are continuing our work in three areas: (i) mating system evolution, (ii) parental care evolution, and (iii) alternative life history evolution.

The work on alternative life histories in sunfishes presently focuses on the genetic basis for the two reproductive strategies: cuckolders and parentals. Dr. David Philipp and I, together with assistants, measured the paternity of cuckolders in different breeding colonies using electrophoresis. We also began growth experiments to study the environmental contribution to precociality, transferring the embryos to David's aquatic research facilities at the Illinois
Natural History Survey (Champaign, Illinois).

Ron Coleman spent his first summer at Opinicon, testing some aspects of parental investment theory related to "decision making". Ron may have helped to clear up an area of theory called the "Concorde fallacy".

The mating system studies were primarily concentrated on variance in male success. This has been a problem of long-standing interest because of its relationship to sexual selection theory.

**Assistants:** Dr. William Harvey, Jeff Van Orman, Jeff Koppelman, Angela Boerger, Karen Kerestes

**Publications:**


Life history theory proposes that a parent with offspring is faced with a tradeoff between investing in the current brood and investing in future broods. To decide its current level of investment, a parent may use indicators of the value of the brood at stake, and/or indicators of the value of the parent's expected future reproduction. By manipulating brood size, I tested the sensitivity of nesting parental male bluegill sunfish to two such factors, namely brood size and past investment. The results support the hypothesis that bluegill sunfish incorporate both past investment and brood size into their decision rule, and reject alternative hypotheses that bluegill incorporate only one of the two factors or neither into their decision rule.

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

"Fish Gene Pools"

In conjunction to my research with Dr. M. Gross, 1984 included studies on the long term stability of the genetic composition of individual bluegill sunfish colonies and differences between colonies in the lake system.

**Assistants:** Dr. William Harvey, Jeff Van Orman, Jeff Koppelman, Angela Boerger, Karen Kerestes (all INHS).
"Water Mite Parasitism of Waterstriders"

Waterstriders (Hemiptera: Gerridae) bearing large numbers of limnocharid mites have been recorded from several Ontario localities, one being Chaffey’s Locks. The purpose of this study is to determine what impact these mites have on their hosts.

In 1984, I continued sampling waterstriders in Deadlock Bay to further document the seasonality of infestation and the distribution of parasitic mites among species and life-history stages of the host community. These samples are presently being sorted. Laboratory experiments were conducted to determine which life-history stage of a host was most susceptible to parasitism. Given equal exposure to mites, a late life-history stage was parasitized by more mites than all preceding stages. However, the opposite relationship was true for the mite burden in proportion to the host’s body size. Because impact is generally related to proportional load of parasites, it would be expected that the greatest impact of parasitism in natural populations would be upon first instar juveniles. In experiments with newly hatched waterstriders, mortality and duration of instar were directly related to the number of mites infesting the host. With an average of nine mites per host, 85% of first instar nymphs dies before reaching second instar and the duration of first instar was increased by 50% for surviving hosts. In 1985, I plan to conduct enclosure experiments to study the effects of mite parasitism on the success and age structure of waterstrider populations.

"Demography of Pinus rigida and Vaccinium corymbosum"

After a decade of high mortality, the northernmost stand of Pitch Pine, which is located along the Rideau Canal near Jones Falls, is showing some signs of recovery. Since 1967, when the first census was taken, 120 trees have perished. However, in the last three years, none of the remaining 21 trees have succumbed and, indeed, several are now bearing seeds, but no seedlings have as yet been observed.

The 50 tagged *V. corymbosum* plants in Herbert Bog are still trying to recover from the 1980 cold snap. This severe cold killed the perennating buds on many stems, resulting in their demise. However, many of the new shoots which arose from the root-crown after the death of the older stems are now being browsed by rabbits and hares.

Indeed, in 1984, only 28% of the tagged shrubs bore any fruit at all and, of these, only one plant produced more than 300 berries. Seed set per berry was only 9.5 viable seeds.

Publications:

VanderKloet, S. 1984. Differences in vegetative and reproductive growth among Ontario, Nova Scotia and Newfoundland populations of


DR. P. WEATHERHEAD - Dept. of Biology, Carleton University

"Song Sparrows: nest defence behaviour and breeding dispersal"

The 1984 field season marked the completion of a 5 year study of several aspects of the breeding biology of song sparrows. Questions being addressed with regard to nest defence behaviour related to the effect of renesting potential on risk taking. Both within season and between season renesting potential were considered. The research also continued to focus on the unusually high degree of within-breeding season movements by breeding birds. The data collected in 1984 in conjunction with data from previous years should allow me to assess both the causes and consequences of these movements.

Assistants: Karyn Boak, Monica Locher, Sheila Macfie

"Ecology and behaviour of black rat snakes"

Regular trips were made to the field station through the winter and spring in 1984 to record body temperatures of snakes in the two hibernacula, using radio telemetry. The spring emergence and dispersal were monitored in April and May. Subsequently, the work on snakes was restricted to marking and measuring individuals as they were captured throughout the summer.

Assistants: Brent Charland, Monica Locher, a cast of thousands.

"Limits to sexual selection in red-winged blackbirds"

A substantial number of red-winged blackbirds had been collected over 2 spring and 2 fall roosting periods at the same roost in Quebec several years ago. The aim of these collections was to compare the morphology of birds from spring and fall collections to test predictions from sexual selection theory regarding the factors which act to check sexual selection. After lying almost dormant in freezers (and not so freezers), the specimens, or parts thereof, were brought to the field station for measurement, a task successfully completed by summer's end.

Assistant: Brent "Stinky" Charland

Christopher Eckert - Dept. of Biology, Carleton University

"The correlation between male and territory quality in red-winged blackbirds". M.Sc. thesis.

A principal underlying assumption of the polygyny threshold model of mate choice is that male and territory quality are perfectly
positively correlated, i.e. the best males get the best territories and vice versa. The aim of this study is to test the assumption using an experimental approach. The quality of territorial males was assessed through a combination of behavioural tests. These males were then removed and the tests repeated on their replacements. Comparison of the two groups will indicate the extent to which the quality assumption is valid. This work will continue in 1985 and will include research to be conducted in the newly constructed aviary.

Publications:

Table 1: Summary of course credits in the Ontario Universities Program in Field Biology earned at Queen's University Biological Station in 1984

<table>
<thead>
<tr>
<th>Module Topic</th>
<th>Professor &amp; Affiliation</th>
<th>Credit/Student</th>
<th>Queen's</th>
<th>Carleton</th>
<th>York</th>
<th>Brockton</th>
<th>Waterloo</th>
<th>Other</th>
<th>Total Students</th>
<th>Total 1/2 course credits</th>
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<td>Breeding Behaviour of Birds: Territoriality</td>
<td>Weatherhead (Carleton)</td>
<td>May 6</td>
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<td>Keast (Queen's)</td>
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<td>Bat Behaviour and Caves</td>
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Total Number of Student-Weeks: - - - 38 20 26 7 11 0 0 102 -

Half-Course Credit Equivalent: - - - 19 10 13 3.5 5.5 0 0 - 51
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<th>Module Topic</th>
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<th>Dates</th>
<th>Location</th>
<th>Credit/Student</th>
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<th>York</th>
<th>Brock</th>
<th>Western</th>
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<th>Total 1/2-course credits</th>
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<td>High Arctic Tundra</td>
<td>Cameron &amp; Lewis (York)</td>
<td>Jul.18 - Aug.8</td>
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<td>Algonquin</td>
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<td>Millar (Western)</td>
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<td>Keenleyside (Western)</td>
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| Total Number of Student - Weeks | - | - | - | - | 24 | 21 | 22 | 5 | 7 | 0 | 0 | 79 | - |
| Half-Course Credit Equivalents | - | - | - | - | 12 | 10.5 | 11 | 2.5 | 3.5 | 0 | 0 | - | 39.5 |
Table 3: Overall Summary of the Ontario Universities Program in Field Biology for 1984

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<th>Queen's</th>
<th>Carleton</th>
<th>York</th>
<th>Brock</th>
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<th>Waterloo</th>
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<th>Total Student Weeks in Modules</th>
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<td>Dr. P. W. Colgan (Queen's)</td>
<td>Field Ethology of Fishes</td>
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<td>Behavioural Ecology of Darters</td>
<td>Sid Arnold (Queen's)</td>
<td>Apr. 21-Sept.6</td>
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<td>Feeding Behaviour of</td>
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<td>Dr. A. Crowder and Dr. R. Harnsen (Queen's)</td>
<td>Effects of grazing on old field succession</td>
<td>Bruce Henderson (Queen's)</td>
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<td>PCP Effects on Physiology and Behaviour in Bass</td>
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<td>PCP Effects on Development of Behaviour in Bass</td>
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<td>Dr. J. A. Keast (Queen's)</td>
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<td>David Booth (Queen's)</td>
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<td>May 25, 26, Jul.1</td>
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<td>Pollination Ecology</td>
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<td>Kevin Teather (Queen's)</td>
<td>May 1-Aug.1, Aug.28, 31, Sept.1,2,79</td>
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<td>Mike Studd (Queen's)</td>
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<td>Darlene Parsons (Queen's)</td>
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<td>Delayed Plumage Maturation in Female Tree Swallows</td>
<td>Bridget Stutchbury (Queen's)</td>
<td>Apr. 30-Aug. 2, Aug. 19-31, Sept. 1, 2 Apr. 30-July 18</td>
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<td>Katie MacKay (Queen's)</td>
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<td>Paternal Care in Redwings</td>
<td>Caroline Wallace (Queen's)</td>
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<td>Dr. N. C. Collins (U. of T., Erindale)</td>
<td>Social Interaction and Growth in Bluegill</td>
<td>May 19-31, June 17-July 21</td>
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<td>Food Limitation in Bluegill</td>
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<td>Whip-poor-will Breeding Strategies</td>
<td>May 1-July 26</td>
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<td>Alex Mills (Carleton)</td>
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<td>Gay Weir (Carleton)</td>
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<td>May 5-June 1, June 4-9, 19-30</td>
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<td>June 14-23</td>
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Other Visitors to QUBS 1984

Jackie Studd
Shelagh Mathers
Vic Nishi
Morgan Hull (Queen’s – Education)
Jennifer Smith
Lois Deacon (Queen’s)
Hildegard Dorosch
Sher Bovay (Queen’s)
Bruce Henderson (Queen’s)
Mike Stoneman (Carleton)
Jim Complak
Anne and Jenny Booth
Paul Chippendale (Carleton)
Gary Ridout (MNR-RLAU)
Joe Boraski (MNR-RLAU)
Joe Cebek (Trent)
Barb Dowsley
Lynn Brodsky (Queen’s)
Steve Crawley
Mark Malloy
Tracey Wood
Mark Brigham (Carleton)
Virginia Wai-Ping (Carleton)
Andy Westcott (Carleton)
Cam Eckert
Dr. Bob and Carolyn Goulen (Ill. Nat. Hist. Survey)
Barb Martin
Mike Maguire
Bill Mulvihill
Dr. Gray Merriam (Carleton)
Dr. M. B. Fenton (Carleton)
Dr. K. Storey (Carleton)
Dr. Pete Blancher (Queen’s)
Vytenis Gotceitas (Queen’s)
Betty Jean Ashley
Linda Sorensen (Queen’s)
Dr. Glenn Morris (U. of T., Erindale)
Dr. Marylee Stephenson
Steve Hindmarch
James Irving
Pat Walker
Andy Hurly (Queen’s)
Faye Murrin (Queen’s)
Doug Menard
Barb Hilder (Queen’s)
Rob Alvo (Trent)
Corrine De Korte
Reg Best
Lori Cloviter
Robin Whitall
Jean and Elsa Templeton
Dr. L. Soluk (U. of T., Erindale)
Sarah Peters
Nigel Lester
Jill Lightbody (Carleton)
Kim Stutchbury
Dr. George Williams (SUNY)
Greg Davies
Dr. Peter Boag (Queen's)
Sarah Morgan
Kerry Walsh
Robin Scribalo (U. of T.)
Keith, Shirley and Adam Miller
Bruce Furlonger
Steve Smith
Dr. John Spence (U. of Alberta)
Dr. Michael Bristow
Terry Armstrong (Queen's)
Julia McCrea (Environment Canada)
Jennifer Harker (Dillon Consultants)
Dr. John Alcock (U. of Arizona)
Dr. John Toohey
Julie Dale (U. of Guelph)
Dr. Adrian Forsyth
Turid Hoelldobler-Forsyth
CBC - Nature of Things Film Crew
Table 4, Part 2: Documentation of Research Use for 1984 (April 1–Sept. 8)

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| **External**  |            |                |              |       |
| U. of Toronto:|            |                |              |       |
| Barrett       | 0          | 0              | 2            | 2     |
| Collins       | 38         | 77             | 114          | 229   |
| Fullard       | 35         | 0              | 81           | 116   |
| **Total**     | **73**     | **77**         | **197**      | **347** |

| Carleton:     |            |                |              |       |
| Fenton        | 0          | 87             | 82           | 169   |
| Weatherhead   | 68         | 116            | 358          | 542   |
| **Total**     | **68**     | **203**        | **440**      | **711** |

| Simon Fraser: |            |                |              |       |
| Gross         | 41         | 69             | 89           | 199   |

| Illinois Natural History Survey: |          |                |              |       |
| Philipp       | 66         | 0              | 90           | 156   |

| Cornell:     |            |                |              |       |
| Smith        | 132        | 0              | 0            | 132   |

| Acadia:      |            |                |              |       |
| VanderKloet  | 6          | 0              | 0            | 6     |
Table 4, Part 2 (cont'd)

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User Days in teaching activities 1633

Miscellaneous user-days (visitors, families of researchers, field trip participants) 1017

TOTAL USER DAYS 5845

(Part-time and full-time support staff are excluded from above figures)
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<td>Bio 300 (Ecology) Weekend</td>
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<td>ALEX MILLS (Carleton)</td>
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<td>JAMES FULLARD (U. of T., Erindale)</td>
<td>&quot;Research in Panama: Sense Cells, Salsa and Sangria&quot;</td>
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<td>&quot;Population Genetics of Northern and Florida Largemouth Bass&quot;</td>
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<td>DAVE BOOTH (Queen's)</td>
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<td>&quot;Behavioural Correlates of Territory Acquisition in the Redwinged Blackbird&quot;</td>
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<td>BRUCE SMITH (Cornell)</td>
<td>&quot;Water Mite Parasitism of Mosquitoes&quot;</td>
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<td>ALEX MILLS (Carleton)</td>
<td>&quot;Breeding Biology of the Whip-poor-will in Relation to Moonlight&quot;</td>
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<td>RON COLMAN (Simon Fraser U.)</td>
<td>&quot;Male Parental Care in Bluegill Sunfish&quot;</td>
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<td>PETER JOHANSEN, ALASTAIR MATHERS, and JOE BROWN (Queen's)</td>
<td>&quot;PCP in Fish&quot;</td>
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<td>BLAKE KONKLE (U. of T., Erindale)</td>
<td>&quot;Planktivory in a Population of Stunted Lake Trout; or Why Big Bait Catch Big Fish&quot;</td>
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<td>JULES RICKARD (Guelph)</td>
<td>&quot;Can Ciliates Adjust Their Intermembranellare Spacing to Prey Size?&quot;</td>
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<td>&quot;Why has delayed plumage maturation evolved in female Tree Swallows?&quot;</td>
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<td>LORNE WOLFE (U. of T./Illinois)</td>
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<td>&quot;Female Parental Care in relation to Territory Quality and Male Parental Care in Yellow Warblers&quot;</td>
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<td>AUG 1</td>
<td>CAROLINE WALLACE (Queen's)</td>
<td>&quot;Male Parental Care in Red-winged Blackbirds&quot;</td>
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<td>SID ARNOLD (Queen's)</td>
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</table>
Table 7: Fee Schedule for 1985

I. ACCOMMODATION (Room and Board)

$220/mo - includes obligation for chores on a rotating schedule
$325/mo - no obligation for chores
$110/wk - including weekend, e.g. Field Camp (includes a lab fee)
$15/day - 24 hr room and board (incl. meals & overnight, no charge)
$2.50 - breakfast only
$2.50 - lunch only
$5.00 - dinner only
$6.50/person - overnight accommodation - academic purposes - no food
$10.00/person - overnight accommodation - non-academic purpose - no food

ACCOMMODATION SURCHARGES (applied as additional % to above charges)

<table>
<thead>
<tr>
<th>Surcharge</th>
<th>Accommodation type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>White House (dormitory), Curran Cottage (multi)</td>
</tr>
<tr>
<td>5%</td>
<td>Cabins 1-7, 9, 10, 12 and shaker</td>
</tr>
<tr>
<td>10%</td>
<td>Cabins 8 (if solo), 11 and White House apartment</td>
</tr>
<tr>
<td>15%</td>
<td>Keast and Earl Cottages</td>
</tr>
</tbody>
</table>

II. BOAT RENTAL

- include maintenance on boats and motors $110/month; $50/week
- Gas and oil not included in rental fee
- Purely recreational use should be limited to non-motorized craft

III. BENCH FEES

$3/day - Non-Queen's staff or major researcher (M.Sc., Ph.D. candidate, project coordinator or Post-doctoral Fellow)

$1/day - each non-Queen's assistant

Bench fees may be reduced or waived if sufficient research funds are not available upon written application to the Station Director, Dr. R. J. Robertson.
Queens University Biological Station
List of Theses

Ph.D THESIS:


M.Sc. THESIS:


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. Dept. of Biology, Queen's University, Kingston, Ont.


M.Sc. thesis, Dept. of Biology, Queen's University, Kingston, Ont.


CURTIS, C. 1946. The soils of the Queen's University Biology Station. M.Sc. thesis, Dept. of Biology, Queen's University, Kingston, Ont.


sity.


B.Sc. THESES:


BRIGHAM, M.R. 1983. The bowing display of the male Brown-headed Cowbird (Molothrus ater) and its importance to social dominance, B.Sc. thesis, Dept. of Biology, Queen's University, Kingston, Ont.


FENTON, M.B. 1965. The distribution of small mammals relative to microclimatic factors. B.Sc. thesis, Dept. of Biology, Queen's University, Kingston, Ont.


MacMILLAN, M.A. 1979. Reduction of brood predation as a possible selective factor in the evolution and maintenance of colonial breeding in the Bluegill sunfish (Lepomis macrochirus). B.Sc. thesis, Dept. of Biology, Queen's University, Kingston, Ont.


McBRIEN, H.L. 1981. The effect of phytophagous beetles of the genus Trichabda Blake (Coleoptera: Chrysomelidae) on plant succession in a Solidago canadensis L. (Asteraceae) community. B.Sc. thesis, Dept. of Biology, Queen's University, Kingston, Ont.


NOWELL, W.A. 1977. Spatial aspects of defense in Pumpkinseeds sunfish (Lepomis gibbosus) including a catastrophe theory model. B.Sc. thesis, Dept. of Biology, Queen’s University, Kingston, Ont.


SCHUT, P.H. 1981. Some aspects of competition between Myriophyllum spicatum and other aquatic macrophytes B.Sc. thesis, Dept. of Biology, Queen’s University, Kingston, Ont.


SOUDEK, D. 1975. Seasonal changes in the phytoplankton of Lake Opinicon. B.Sc. thesis, Dept. of Biology, Queen’s University, Kingston, Ont.


SUTHERLAND, D.L. 1984. Intersexual and intrasexual foraging differences in relation to habitat structure and prey abundance in the Yellow
Warbler (Dendroica petechia). B.Sc. thesis, Dept. of Biology, Queen's University, Kingston, Ont.


WEBB, D.E. 1964. The structural and functional features related to the food and feeding habits of the fishes of Lake Opinicon. B.Sc. thesis, Dept. of Biology, Queen's University, Kingston, Ont.

WERSUB, L. 1950. Preliminary work in physiological and ecological studies of vegetation at Queen's University Biological Station, Chaffey's Lock, Ontario. B.Sc. thesis, Dept. of Biology, Queen's University, Kingston, Ont.


Queen's University Biological Station
List of Publications

Updated 1st April 1985


Ballantyne, P. K. and Colgan, P. 1978. Sound production during agonistic and reproductive behaviour in the pumpkinseed (Lepomis gibbosus, the bluegill (L. macrochirus), and their hybrid sunfish. I: Context. Biol. of Behav. 3: 113-135.

Ballantyne, P. K. and Colgan, P. 1978. Sound production during agonistic and reproductive behaviour in the pumpkinseed (Lepomis gibbosus, the bluegill (L. macrochirus), and their hybrid sunfish. II: Recipients. Biol. of Behav. 3: 207-220.

Ballantyne, P. K. and Colgan, P. 1978. Sound production during agonistic and reproductive behaviour in the pumpkinseed (Lepomis gibbosus, the bluegill (L. macrochirus), and their hybrid sunfish. III: Response. Biol. of Behav. 3: 221-232.


Colgan, P.W. 1974. Burying experiments with the banded killifish,


vascular plants on the diurnal fluctuations of temperature near
the water surface in the early spring. Hydrobiologia, 49: 245-
256.


Fenton, M.B. 1969. Summer activity of *Myotis lucifugus* (Chiroptera:
Vespertilionidae) at hibernacula in Ontario and Quebec. Can.

Fenton, M.B. 1970. A technique for monitoring bat activity with
results obtained from different environments in southern Ontario,

Fenton, M.B. 1970. The deciduous dentition and its replacement
J. Zool. 48: 817-820.

Fenton, M.B. 1970. Population studies of *Myotis lucifugus*
R. Ont. Mus. No. 77, pp. 1-34.

Fenton, M.B. 1971. Bats . . . questions, answers and issues. The

Fenton, M.B. 1972. The structure of aerial-feeding bat faunas
as indicated by ears and wing elements. Can. J. Zool. 50:
287-296.

Fenton, M.B. 1972. Distribution and overwintering of *Myotis
leibii* and *Eptesicus fuscus* (Chiroptera: Vespertilionidae)
in Ontario. Royal Ontario Museum, Life Sciences Occasional
Papers No. 21.


Fenton, M.B. 1977. Variation in the social calls of little brown

in four species of *Myotis* (Chiroptera). Can. J. Zool. 57:
1271-1277.

Fenton, M.B. and G.P. Bell. 1981. Recognition of species of insecti-

Responses of *Myotis lucifugus* (Chiroptera: Vespertilionidae)
to calls of conspecifics and to other sounds. Can. J. Zool. 54:
1443-1448.

Fenton, M.B. and J.H. Fullard. 1979. The influence of moth hearing on
bat echolocation strategies. J. Comp. Physiol. 132: 77-86.


Riotte, J.C.E. 1973. Observations on seasonality in some moth species, made over the last four years at the biological station of Queen's University at Chaffey's Locks, Ontario. The Blue Bill. 20 (No. 3): 51-53.


