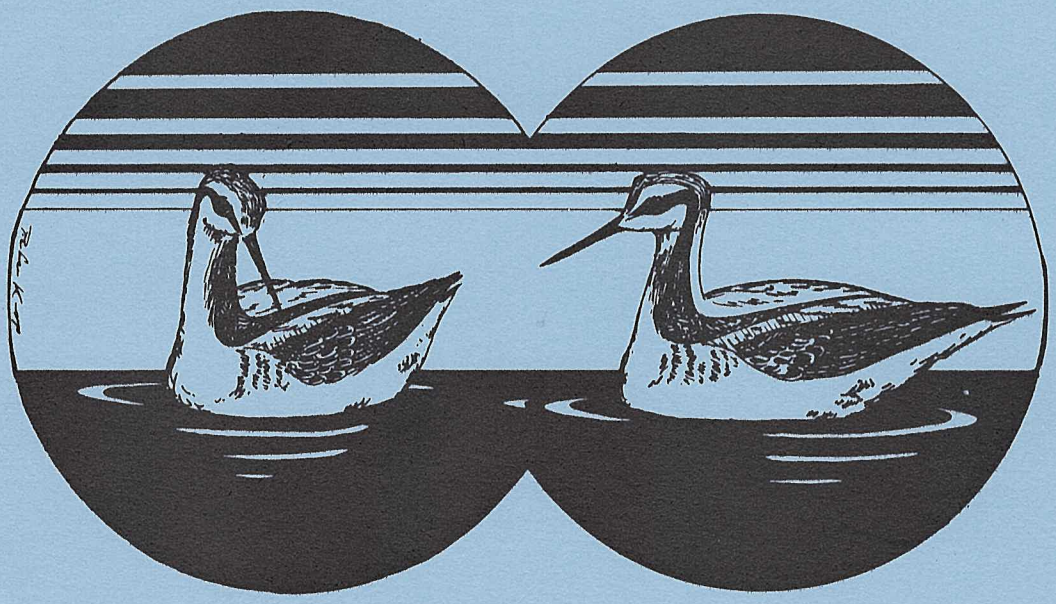
THE BLUE BILL
Quarterly Bulletin of the
Kingston Field Naturalists
Vol. 36 #2 ISSN 0382-5655

INTERPRETING NATURE



A Special Issue on the Natural History of Eastern Ontario

in honour of the

40th Anniversary of the Kingston Field Naturalists

and the

58th Annual Meeting and Conference of the Federation of Ontario Naturalists

26 - 28 May 1989
Kingston, Ontario

T H E B L U E B I L L

QUARTERLY BULLETIN
OF
THE KINGSTON FIELD NATURALISTS
P.O. Box 831, Kingston, Ontario
K7L 4X6

2nd Class Mailing Registration No. 6310

SPECIAL ISSUE IN HONOUR OF
THE 40TH ANNIVERSARY OF
THE KINGSTON FIELD NATURALISTS
AND
THE 58TH ANNUAL MEETING AND CONFERENCE OF
THE FEDERATION OF ONTARIO NATURALISTS

Volume 36, No. 2 TABLE OF CONTENTS June 1989

Cover: "Wilson's Phalaropes through Binoculars"
F.O.N. Conference Logo designed by Peter Knapp

EDITOR'S NOTE

We extend a very warm welcome to all delegates in Kingston for the Federation of Ontario Naturalists Annual Meeting and Conference 1989.

1989 is the 40th birthday of the Kingston Field Naturalists and what better way could we find to celebrate than to invite our naturalist friends from all across the province to come and share it with us. The theme of the conference, as you know, is INTERPRETING NATURE. In keeping with that theme we offer this special edition of The Blue Bill to give you an excellent introduction to the many natural riches of the Kingston area.

Most of the articles were written by local experts for another special edition which we produced for the International Council for Bird Preservation (I.C.B.P.) which met here in June of 1986. We co-hosted that meeting with the Queen's University Biology Department and had the great pleasure of meeting fellow birders from all over the world.

The authors of the articles have updated the information where necessary and we thank them for giving us permission to reprint them for you.

The introductory article is a history of our own Club written by Dr. Robert B. Stewart. Bob was Charter member of the Kingston Field Naturalists, served two terms as its President and was one of the early editors of Blue Bill. His wife, Nan, is the daughter of our Club's founder, Dr. George Stirrett. F.O.N. members will remember Bob's excellent two-year term as its President and his long-standing and continued work and support for the Federation.

I hope you will enjoy these articles and find them useful in helping you to "interpret nature" in our area.

I would like to thank all of those Club members and others who have helped in any way in the production of Blue Bill during the five years I have been its editor. It has been a rewarding and enlightening experience.

Faith Avis

THE KINGSTON FIELD NATURALISTS - FORTY YEARS

by Bob Stewart

The Kingston Field Naturalists are pleased to host the 58th Annual Meeting and Conference of the Federation of Ontario Naturalists as a part of our celebration of forty years activity as a naturalists organization. While forty seems rather like "just getting started" compared to the Ottawa Field Naturalists who are 110 years this year and the McIlwraith Club of London who will celebrate their 100th anniversary next year, we are nevertheless proud of our accomplishments during our brief history. This will be the fifth time we have hosted the F.O.N. The previous meetings were in 1951, 1965, 1974 and 1982. On several of those occasions, as well as on others, the Blue Bill and other media carried accounts of our history (Stewart, 1954; Quilliam, 1974; Evans, 1982; Mason, 1982).

While we officially came into being in November of 1949 as the Kingston Nature Club, there was a considerable amount of organizational activity which preceded. This began with the arrival of Dr. George M. Stirrett in Kingston in 1948, as the wildlife officer for Ontario in the relatively new Canadian Wildlife Service. Dr. Stirrett had been Director of the Dominion Entomological Laboratory in Chatham, Ont. since 1926 and was one of the founders of the Kent Nature Club in Chatham. The first Executive Committee of the F.O.N. in 1931 had George Stirrett from Chatham and G. Toner, representing Queen's Natural Historical Society, as members (F.O.N. Publication No.1, October, 1931). These were two of the seven clubs in the infant federation.

An organizational meeting was held on March 31, 1949, with twenty-two attending. A fall meeting was planned at which time a constitution was to be presented for adoption and two intervening field trips were scheduled. FIve attended the first in late April in heavy rain and fifteen attended the second on June 1. A constitution was adopted on Nov. 24th and George Stirrett was elected our first president. In April of 1950 at our first annual meeting, we voted to join the F.O.N. Our membership at that time was about sixteen and in one year's time we would be asked to host the F.O.N. Conference.

We were all very much beginners and George's background of knowledge and leadership were important to our beginning. Perhaps the most important of all the lessons we learned from George, was that naturalists belong in the field and to be there with a purpose.

Since the very beginning the Kingston club has had a strong orientation toward field projects. Our first bird-banding activity was to continue the Chimney Swift banding program that had been initiated by Prof. R.O. Merriman in 1928 and continued without interruption except for 1941-1944 until 1947 (Bowman, 1952). We took it up again in 1950. Among our other projects during the decade of the fifties was the erection of Wood Duck nesting boxes on the Little Cataraqui Creek, Woodcock and Mourning Dove breeding surveys, mid-winter waterfowl inventories, gull banding on some of the islands in the St. Lawrence River, Christmas bird counts and, importantly, beginning the publication of the Blue Bill in 1954. The thirty-five years of continuous publication has given us an important record of our activities and observations and we hope has been of

value to our readers, some of whom live far from Kingston.

Helen Quilliam and her husband, Brigadier C.D. Quilliam, arrived in Kingston in 1953. Helen involved herself very quickly in the club activities, contributing enthusiasm and energy to many of our programs. The operation of The Old Book Collector on Brock Street, and the Gestetner used to produce book catalogues, launched Helen as the publisher of the Blue Bill, several times Editor and, importantly, gave her a very accurate sense of the changes occurring in our local bird life. When George Stirrett left Kingston in 1959 for Ottawa, to take up his duties as the first Chief Naturalist of the National Parks, Helen continued the column "Local Notes on Natural History" published in the Kingston Whig-Standard. These activities provided her with the insight to write "The History of the Birds of Kingston, Ontario", first published in 1965, saw a new edition in 1973, the year of Kingston's Tercentenary, and a supplement co-authored by Dr. Ron Weir in 1980. Helen has continued to provide leadership and support for many club activities. she has held many of the executive position s in the K.F.N., including the Presidency, has been an F.O.N. Director and was awarded an Honourary Life membership in that organization. The K.F.N. elected Helen as an Honourary President, not only in recognition of her many contributions but as an expeditious way of keeping her on the Executive Committee for as long as she wished to serve and provide us with continuing wise counsel and leadership.

As the fifties were drawing to a close, we found new individuals raising their level of commitment to natural history and conservation. Pres. George Stirrett and Wesley Curran from the Biology Department at Queen's University represented our interests on the F.O.N. Board of Directors in the early half of the decade. In 1957 Dr. Martin Edwards of the Physics Department at the Royal Military College was elected to the F.O.N. Board of Directors and served as K.F.N. President during this period. Martin became the F.O.N. President in 1969.

The sixties with their turbulence and excitement brought naturalists into a new range of activities, many of these associated with a growing concern for the quality of our wildlife and natural areas. Concerned by development and reduction of "unspoiled" woodlands into small parcels, the K.F.N. in 1963 had the opportunity to acquire 85 hectares of land bordering on Otter lake in Loughborough Township. Forty hectares were added in 1967 and a further seventy-seven in 1981. The acquisition of the first property in 1963 resulted in our name change from a Nature Club to Field Naturalists as more legally suitable for charitable organization status and land owner. The proximity of Frontenac Provincial Park contributes to the preservation of a large ecosystem important for the continued nesting of many warbler species. While the Otter Lake Sanctuary does not have the focus of club activities that it once did, it is there and will undoubtedly generate club projects in the future.

The need to preserve wetlands, natural drainage systems and the natural areas around them was a part of the support for the province's regional conservation authorities. Dr. Jim McCowan undertook the enormous task of bringing the Cataraqui Regional Conservation Authority into being. Jim began this task while a chemist at Dupont Canada Limited and is now a member of the Chemistry Department at Queen's. The Authority was established in 1965 and Jim as its

Chairperson until 1970. During this period a major activity of the Authority was the acquisition of land and for this all of us locally are grateful for Jim's foresight. During this time Jim also served as the Recording Secretary for the F.O.N.

Other areas of environmental concern that involved K.F.N. were pesticide accumulation in gull populations. A field trip to Pigeon Island, organized by Martin Edwards in 1963, resulted in the notation of thin-shelled eggs from the birds nesting on the island. This led to further field trips and studies and subsequently was continued by the Canadian Wildlife Service to more fully document the effect of pesticides on our breeding gull population. Among Martin's other related activities during and slightly beyond the sixties was in the formation of the Canadian Natural Federation and service as its President, as well as serving as a one-man Royal Commission established by the Province of Ontario to investigate a sudden die-off of waterfowl on Centre Island at Toronto.

This period saw many of our members undertake responsibility for a number of the 25 mile routes for the North American Breeding Bird Survey. This stimulated the Club to use the same technique to monitor our own area. Rather than a random selection of routes, we selected ours to reflect the diverse habitat of the region with the result that the changes and, in some cases, the causes, are much better understood. Our involvement with Prince Edward Point in Prince Edward County began in 1960 with a field trip. It and subsequent trips began to alert us to the possibility that the point was attracting migrants in both spring and fall from a wide geographical area. Dr. Ron Weir, Department of Chemistry at R.M.C. organized a data collecting system to study spring migration at the Point in 1971. This program continued for two years, requiring daily field coverage from the beginning of April until the end of May. The data more than supported previous speculations and, again with Ron's leadership, our level of activity at the Point increased with the leasing of the Lighthouse (the Red Onion) and the establishment of the Prince Edward Point Observatory. The next few years were of intense activity, not only banding but the fund-raising required to keep the project going - daily banding from spring migration through the autumn migration, including the night banding of Saw-whet Owls in October.

The owl banding still continues and the migration banding serves now to educate students in the Biology program at Queen's and is carried out by members of their faculty on an irregular basis. Inability to acquire stable funding on a continuing basis resulted in the diminution of the Club's efforts at the Point, which is rather a pity in terms of the need for the kind of data that was generated as our habitat is continually being degraded. The Observatory and Lighthouse headquarters served also to provide an insight and experience for students at senior and junior levels that has influenced career choices and an empathy with the natural environment. The data generated by the banding and other biological studies provided the basis for the proposal, initiated by Ron Weir, to the Canadian Wildlife Service to create a National Wildlife Area at the Point. While none of this could be accomplished without the efforts of so many individuals, it is the faith and commitment of dedicated leadership that makes these things happen.

These migration studies also led to Ron's study of the bird kill at the Lennox Generating Station during certain weather patterns during migration. The publication of this highly detailed study added importantly to our knowledge, understanding and methods of controlling at least some of the hazards birds face on migration. Ron has served on the F.O.N. Board and represented them in the contentious hearing related to the acquisition of lands by Parks Canada in the Thousand Islands National Park complex.

Our most recent acquisition of 100 hectares of land adjacent to the "bar" on the east end of Amherst Island as result of the K.F.N.'s own fund-raising and the general support of Wildlife Habitat Canada was also very much an initiative of Ron's. More recent members of F.O.N. will know Ron as the author of "Arrivals and Departures" in Seasons and the author of the sections on the Raptors in the Ontario Breeding Bird Atlas.

There have been so many other activities and so many other people who have given so much of themselves, their time and resources to the K.F.N. programs, that it is not possible to identify all. While many who read this will not likely remind me of sins of commission, there are many of omission. In closing this article I can mention only a few. Anne Robertson has provided inspired leadership for our junior naturalist program over many years. It is recognized as one of the strongest in the Province and Anne has been recognized by F.O.N. awards for her skills in this area, as well as being an often repeated part of the programs at the F.O.N. Annual Meetings. She has brought our junior membership to well over one hundred and many of our executive must shudder at the thought of finding her replacement when she decides she would like to do something else.

Dr. Fred Cooke and the late Dr. Roland Beschel of the Biology Department at Queen's contributed much to our growth over the years. Roland was a superb teacher of botany and the skills in this discipline remaining in the Club are much a result of his efforts. Fred's initiation of adult eduction in natural history in night school sessions at a local high school in the late 60's brought us many new members. Fred and his students' (both graduate and undergraduate) contributions to our natural history projects have been invaluable, as has been his professional expertise. Fred has also served as an F.O.N. Director. Other more recent K.F.N. Executive who have served on the Board and Executive Committee of the F.O.N. are: Dr. Ron Black, Dr. Mike Evans, Dr. Laurie Wright, and Faith Avis.

To those I have mentioned, as well as to so many I haven't identified, we all owe a debt of gratitude for making a fortieth anniversary both possible and certainly worth celebrating.

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VEGETATION AND BIRDS: KINGSTON REGION

by Adele A. Crowder

Ice retreated from the Kingston area over ten thousand years ago, leaving a complex landscape with rocky ridges, till plains, drumlins and eskers. Postglacial lakes bequeathed further complexity in the form of deltas, lake beds and poorly drained areas which have become wetlands.

The history of revegetation of this landscape has been reconstructed from sediments in lakes and peaty sites, using pollen, macrofossils, chrysophyte scales, diatoms and plant pigments. Little Round Lake is among the best known sites (Brown et al. 1977) and the type site for pollent analysis is Harrowsmith Bog (Terasmae 1968, Bernabo and Webb 1977).

After the ice retreated, the first phase of forest was dominated by spruce and birch. By 9000 B.P. (Before Present) pines had become dominant, as they had earlier been in New York State. The pine forest included abundant jack pines. During the period 7000 to 4000 B.P., Beech, birch, maple, hemlock and oaks increased in relative numbers as the forests migrated northwards. The northernmost extension of the Boreal spruce forest (the word Boreal means northern) occurred between 5500 and 3000 B.P. Subsequently there was a retreat of the forest zones, lasting until the period of European colonization.

These changes indicate climatic instability, since vegetation grows in equilibrium with climate. At present the Boreal forest lies in the area over which Arctic air masses prevail (Dryson 1966), where the growing period is seldom longer than three months. South of this is a mixed coniferous-deciduous forest, the Great Lakes-St. Lawrence Forest. In the Boreal forest, dominant trees include spruces, balsam fir, tamarack, aspen and white birch, generally growing with a ground cover of feathermosses and lichens, while in the mixed forest white pine, red and white oaks, sugar maple, basswood and yellow birch are abundant. In the mixed forest there is a rich spring flora where violets, trilliums, spring beauties and many other species flower before the trees are in leaf.

The Kingston area is at the junction of these two types of forests and alternate patches of each can be seen, for example when travelling between Ottawa and Lake Ontario. In southern Ontario the mixed type grades into deciduous forest, which continues south of the Great Lakes (Rowe 1959).

In this ecotone, or boundary zone, microclimate and aspect are important in determining plant communities. On souther aspects, which are warm and dry, oak and shagbark hickory trees may occur, while on contiguous but cooler northern aspects, hemlock and white cedar predominate, and the ground flora on the cooler aspects has more ferns and mosses. The coldest areas, such as deep rock basins, can be thought of as boreal pockets left behind during the migrations of the forest. In such basins, peat bogs or fens have developed, where *Sphagnum* mosses surround black spruce and shrubs, such as Labrador tea, sweet gale, leather leaf, and cranberries (Khoo 1981). The hottest driest sites, for example sand dunes with pitch pine or stands of red cedar with sand cherry, can be thought of

as analogous to vegetation that occurred during the earlier warmer Hypsithermal period.

The post-glacial Boreal forest presumably offered opportunities similar to those which the present coniferous forest gives birds - seeds for siskins or chickadees and multitudinous insects for the warblers. Bogs now provide specialized summer sites for Nashville warblers, and the deciduous areas provide seeds such as maple keys for evening grosbeaks.

The warmest sites such as the north bank of the St.Lawrence River make favourable overwintering habitat. Both deciduous and coniferous trees here are eaten by many insects such as sawfly and moth larvae, whose populations periodically peak and crash. Predation by birds is insufficient to control outbreaks of spruce budworm, tent caterpillars, or the current plague, the gypsy moth (Rose and Lindquist 1973, 1977, 1982).

While climate was the main factor causing postglacial changes in vegetation, differential rates of migration have also been important. The Boreal forest trees are dependent on wind for both pollination and seed dispersal, and so can colonize new ground rapidly. Some of the deciduous trees, however, need pollinators, and also depend on absent-minded squirrels to trundle their heavy seeds or fruits into winter hoards, which they abandon. The migration of a species with a heavy acorn or nut is therefore slow.

For plants, Lake Ontario was and is a barrier to dispersal. Possible northward routes were round each end of the lake, and during periods of low water across from Jefferson County, New York, to Prince Edward County. Around 8700 B.P., the lake level has been estimated to have been 20 m. below the present level (Lewis and McNeely 1967) allowing easy migration along this route, which is now a chain of islands.

Plants with a mainly southern (Carolinian) distribution are concentrated at the ends of the Lake, in the Niagara and Thousand Island areas (Soper 1962). It is debatable if they are remnants of the earlier more favourable climate, or late migrants. In the Kingston region they include rue anemone *(Anemonella thalictroides)*, deerberry, and the aquatic aroid *Peltandra virginicum*. The last two have fruits which are eaten by birds.

Migration is a continuing process. Species which are at present rapidly spreading include helleborine, strangling dogvine, and the aquatics Eurasian milfoil and frogbit. Since the eighteenth century the main migrations have been those of introduced weeds or of escaped crop plants and ornamentals. Perhaps before thistles spread there were fewer goldfinches?

Before the colonial period Indian farmers cleared forests, for example in Prince Edward County. They continued to burn land near Rice Lake until the nineteenth century (Moodie 1871). Some stands of very large pines, used for the Royal Navy's reserves, may have originated as successional trees in abandoned Indian fields (McAndrews 1970).

Since the arrival of the Empire Loyalists at the time of the American Revolution, deforestation and agriculture have greatly altered plant distribution. There is now little mature forest. Selective lumbering has reduced numbers of oaks and pines, while maple trees have been kept in farm lots for sap production. Long-lived species such as hemlock and beech have declined, while smaller trees like ironwood have increased in relative numbers.

Lumbering and clearances increased the frequency of fires in the nineteenth century. In Barron Township (Algonquin Park), the mean number of years between forest decreased to 14 during the period 1696 to 1920 (Cwynar 1977). Some contemporary stands of pines and birch and areas of blueberry heath occupy sites of fires. Previously in the history of the vegetation, the post-glacial pine period also had a high frequency of occurrence of fire with up to two per century at the transition zone of forest types in Algonquin Park (Terasmae and Weeks 1979).

Open conditions in the nineteenth century landscape brought in Bobwhite Quail and other birds which like a terrain similar to the prairies (Quilliam 1973). Bobwhites partially digest the seed coats of shrubs at the edges of prairie in the United States, increasing their chances of permination. It seems possible that some of our rare shrubs such as the shining sumac *(Rhus copallina)* may have owed their establishment to passage through a Bobwhite's gut (Crowder 1982).

The farming population in eastern Ontario began to decline in the 1880's and since then much land was reverted to forest, or is in the process of doing so. In lightly grazed land, spiny or prickly shrubs, such as prickly ash, hawthorns, junipers and red cedars, spread. Both in meadows and abandoned arable fields the patterns of dispersal of colonizing shrubs and trees are often due to seeds dropped by birds. Apples, dogwoods, blackberries and raspberries from encroaching thickets, together with sumac and poison ivy.

The successional habitats provide a great deal of 'edge', and so maintain a high diversity of bird species. Openings are also important even within the forest; for example, the Ruby-throated Hummingbird finds nectar in flowers on open sites. In spring columbines flower on rock ridges or cliffs, and in late summer the main source of nectar is touch-me-not (Bertin 1982) growing on open shorelines or on beaver dams. Another nectar-secreting flower is the Indian paintbrush *(Castilleja coccinea)* which is found on open limestone areas called alvars (Catling et al. 1975).

The mosaic of landforms and immature post-glacial drainage have created wetlands that include bogs, fens, marshes and swamp forest in the Kingston region. Marsh is the most widespread type, which includes inland sites and coastal marshes along Lake Ontario. Some coastal sites have sedge meadows that are grazed by Canada geese every year. The productivity of the wetlands varies from oligotrophic sites to marly lakes with edible beds of *Characeae*, and to extremely lush submerged weed beds containing food plants such as sago pondweed and water celery. Pondweed has been available as duck food throughout the palaeoecological record in some wetlands, as is evidenced by its large shiny fossil seeds. During that time some basins have radically changed as bird habitats, filling in and changing into swamp forests while others have changed

little. Drainage has caused considerable loss of wetland, though less than in southern Ontario (Van Patter and Hilts 1985). Eutrophication and pollution have diminished the diversity of plants in some surviving sites (Crowder and Bristow 1986), for example, where wild rice has been lost and cattail marshes have spread: such a change has diminished habitat for ducks in favour of that for Red-winged Blackbirds, Rails or Bitterns. In a few areas wetlands have been created - for example while 'cranberry bogs' were drained by the making of the Rideau Canal in the 1830's, extensive marshes were formed near Smith Falls.

It has been the intention of these notes to show the inter-relationships of changing vegetation and birds. The plants provide food and shelter, and are the habitat of edible arthropods, but the birds have, for thousands of generations, influenced the vegetation by their selection of edible fruits, seeds and buds, of grazing sites or nectar sources, or by destroying phytophagous insects.

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WILDFLOWERS OF THE KINGSTON REGION

Summer - June

by R.D. Ussher

(Ed. note: This is the second of a series of blooming times of wildflowers prepared earlier for Blue Bill and submitted here especially for the F.O.N. Conference attendees).

The species included in this account are listed in the "Vascular Plants of the Kingston Region", 1970, R.E. Beschel et al., published by the Fowler Herbarium of Queen's University. Common names are those in the Peterson Field Guides (Peterson and McKenny 1968, Petrides 1958). Some shrubs and trees with flowering plants are included in this article but in general, grasses, sedges,

rushes and garden weeds with inconspicuous flowers are excluded. I am grateful for plant lists of species, many with flowering dates, found at Prince Edward Point, compiled by Penny Briggs, and for lists of flowers, shrubs and trees from the same area made by Dr. Crowder.

Dates shown below are those when the plant can be expected to begin blooming. Typical habitat is given in order to guide readers to the sort of place where the plant is likely to be found.

SPECIES		FLOWERING DATE	HABITAT
Bunchberry	*(Cornus canadensis)*	June 1	Woods
Pink Lady's Slipper	*(Cypripedium acaule)*	June 1	Woods
Black Snakeroot	*(Sanicula marilandica)*	June 1	Woods
Yellow Wood-Sorrel	*(Oxalis europaea)*	June 1	Roadside, gardens
Wild Sarsaparilla	*(Aralia nudicaulis)*	June 1	Woods
Water Arum, Wild Calla	*(Calla palustris)*	June 2	Marshes
Goat's Beard	*(Tragopogon dubius)*	June 3	Open places
Blackberry, Bramble	*(Rubus allegheniensis)*	June 4	Forest openings, fields
Silvery Cinquefoil	*(Potentilla argentea)*	June 4	Dry open places
White Clover	*(Trifolium repens)*	June 6	Meadows, lawns
Orange or Tawny Hawkweed	*(Hieracium aurantiacum)*	June 1	Open places lawns
Hounds' Tongue	*(Cynoglossum officinale)*	June 6	Pastures
Smooth Rose	*(Rosa blanda)*	June 7	Roadsides, dry open areas
Ox-eye Daisy	*(Chrysanthemum leucanthemum)*	June 7	Fields, pastures
Red Clover	*(Trifolium pratense)*	June 9	Meadows
Larger Blue Flag	*(Iris versicolor)*	June 10	Wet open places
Yellow Goat's-Beard	*(Tragopogan pratensis)*	Early June	Open places
Nightshade	*(Solanum dolcamara)*	Early June	Thickets, wood edges
Dame's Rocket	*(Hesperis matronalia)*	Early June	Old farmsteads, stream banks
Indian Cucumber-Root	*(Medeola virginiana)*	Early June	Woods
Labrador Tea	*(Ledum groenlandicum)*	Early June	Sphagnum bogs
Bullhead-Lily	*(Nuphar variegatum)*		Quiet waters
Nannyberry	*(Viburnum lentago)*	Early June	Damp fencelines

Mountain or Wild Honeysuckle	*(Lonicera dioica)*	Early June	Openings in woods
American or Climbing Bittersweet	*(Celastrus scandeus)*	Early June	Fencelines, woodland edges
King Devil, Yellow Hawkweed	*(Hieracium pratense)*	Early June	Pastures
Shortstalk Arrowwood	*(Viburnum rafinesquianum*	Early June	Rocky open places
Tall Meadow-Rue	*(Thalictrum polygamum)*	Early June	Damp open places
Mossy Stonecrop, Wallpepper	*(Sedum acre)*	June 13	Open, often on rock
Bladder Campion	*(Silene cucubalus)*	June 14	Fields
Hairy Beardtongue	*(Penstemon hirsutus)*	June 14	Fields and open woods
Viper's Bugloss	*(Echium vulgare)*	June 15	Dry open places
Yellow Sweet Clover	*(Melilotus officinalis)*	June 16	Roadsides, open places
Rough-fruited Cinquefoil	*(Potentilla recta*	June 16	Pastures
Wood Lily	*(Lilium philadelphicum)*	June 19	Woods
Butter-&-Eggs, Toad-flax	*(Linaria vulgaris)*	June 19	Open places, garden weed
Deptford Pink	*(Dianthus ameria)*	June 20	Dry open places
Fragrant Water-Lily	*(Nymphaea odorata)*	Mid-June	Quiet waters
Alfalfa, Lucerne	*(Medicago sativa)*	Mid-June	Meadows
Common St.Johnswort	*(Hypericum perforatum)*	Mid-June	Open places
Sundrops	*(Oenothera fruiticosa)*	Mid-June	Open woods, meadows
Daisy Fleabane	*(Erigeron annus)*	Mid-June	Open places
Harebell	*(Campanula rotuindifolia)*	Mid-June	Meadows, lawns
Yarrow	*(Achilles millefolium)*	Mid-June	Open places
Thyme-leaved Sandwort	*(Arenaria serpyllifolia)*	Mid-June	Open places
Shinleaf	*(Pyrola elliptica)*	Mid-June	Woods
Cypress Spurge	*(Euphorbia cyparissias)*	Mid-June	Open places, cemeteries
Round-leaved Sundew	*(Drosera rotundifolia)*	Mid-June	Moist sands, bogs
Heal-all, Selfheal	*(Prunella vulgaris)*	Mid-June	Open places, paths
Feverwort, Tinker's Weed	*(Triosteum perfoliatum)*	Mid-June	Open woods
Blue Vervain	*(Verbena hastata)*	Mid-June	Open moist places
Common Mullein	*(Verbascum thapsus)*	Mid-June	Open places
Twinflower	*(Linnaea borealis)*	Mid-June	Woods
Pitcher-plant	*(Sarracenia purpurea)*	Mid-June	Bogs

Stinging Nettle	*(Urtica dioica)*	Mid-June	Moist open places
White Avens	*(Geum canadense)*	Mid-June	Open woods
Common Milkweed	*(Asclepias syriaca)*	June 25	Roadsides, fields
White Sweet Clover	*(Melilotus alba)*	June 26	Open places
Silverweed	*(Potentilla anserina)*	Late June	Open places beaches
Grass Pink, Calopogon	*(Calopogon pulchellus)*	Late June	Bogs, marshes
Alsike Clover	*(Trifolium hybridum)*	Late June	Open places
Narrow-leaved Meadowsweet	*(Spiraea alba)*	Late June	Open places usually damp
Rough Cinquefoil	*(Potentilla norvegica)*	Late June	Open places
Bog Twayblade	*(Liparis loeselii)*	Late June	Bogs, wet places
Yellow Avens	*(Geum aleppicum)*	Late June	Open woods, pastures
Helleborine	*(Epipactis helleborine)*	Late June	Woods
Wild Leek	*(Allium tricoccum)*	Late June	Woods
Northern Bush-Honeysuckle	*(Diervilla lonicera)*	Late June	Open, cliffs
Red-panicle or Grey Dogwood	*(Cornus racemosa)*	Late June	Open, fencelines
Basil	*(Satureia vulgaris)*	Late June	Woods
Spreading Dogbane	*(Apocynum androsaemifolium)*	Late June	Open places often dry
Flowering Rush	*(Butomus umbellatus)*	Late June	Wet ditches
Pineapple-weed	*(Matricaria matricariodes)*	Late June	Open, roadsides
Fringed Loosestrife	*(Lysimachia ciliata)*	Late June	Damp thickets, meadows
Purple Flowering Raspberry	*(Rubus odoratus)*	Late June	Woodland margins

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HISTORY OF BIRDS IN THE KINGSTON AREA RELATIVE TO EUROPEAN SETTLEMENT AND HABITAT CHANGES

by Helen R. Quilliam

Even had the first explorers and settlers counted among their number ornithologists or birdwatchers with all our modern equipment, they never would have found the variety of bird life to which we are now heir. Numbers of some species would, however, be considerably different. Whereas we can now count on seeing enormous flocks of Red-winged Blackbirds and European Starlings, our commonest breeding species today, we will never see "many Crane, white as Swans" that Samuel de Champlain saw in 1615 (Grant 1907), nor a flock of Passenger Pigeons more than five miles long such as that recorded near the village of Moscow about 40 kilometres from Kingston at the end of April 1867 (Mitchell 1935).

Almost two hundred years were to pass before human settlement here made much of an impact but, with the end of the American War of Independence and the necessity for Loyalists to find new homes in 1793, settlement began in this region in earnest with the clearing of the forests. Much of the forest on the Canadian Shield has been cut over twice but this section today is once more covered with trees, since only very small patches were suitable for agriculture. However, much of the land on the limestone plain in the southern sector and the larger islands Wolfe, Amherst and Howe, was suitable for agriculture and pasture and therefore had remained cleared, except for the occasional woodlot. Some of this land proved to have only a very thin layer of soil over the limestone and those parts used for pasture were often over-grazed and then abandoned. These have grown up into extensive sections of red and white cedars, and junipers mixed with prickly ash and hawthorns. This process of succession still continues. There has been some drainage of wetlands but on the whole the marshes around Kingston have perhaps suffered less than in many parts of Ontario. They now, however, suffer from other sorts of stress such as control of water levels. Because of these changes the area provides a good variety of habitat for birds, ranging from deep woods, through scrub, fence rows, open fields to cattail marshes, wooded swamps, beaches and muddy shores.

As well as massive changes in habitat, settlement brought about other changes that will be dealt with below. Hunting for both food and fur was an important factor. To the settlers, the abundant wildlife presented what appeared to be an inexhaustible supply. Many settlers had been allotted land on the Canadian shield in sections where farming was impossible and living off the land became a necessity. The introduction of several foreign species of birds has had an impact on native ones. The use of pesticides has had an effect on certain birds at the top of the food chain. Expansion of ranges of native species has added to the diversity of our present wildlife. The building of the Rideau Canal in 1832 was responsible for creating new lakes and "drowned lands", adding further diversity of breeding sites and, with the controlled trapping of beaver, there came an increase in the number of wooded ponds suitable for several species of duck, particularly Wood Duck and Hooded Merganser. Some species have been aided by man's intervention in supplying nesting boxes and winter feeding stations and there has been a concerted effort to save our wetlands and sites that are

particularly useful for birds and other wildlife.

Our knowledge of the composition of the former avifauna of this region is limited but we do have a few historical records which can be augmented by what took place in other parts of Ontario and by what we know of the various requirements of some species. Champlain (Grant 1907) gives us a very short description of the conditions he found when he visited the region in September and October 1615 with a band of Indians. He was much impressed by "a large amount of game as Swans, White Cranes, Outardes, Ducks, Teal, Song Thrush, Larks, Snipe, Geese and several other kind of fowl too numerous to mention. Of these I killed a great number which stood us in good stead while waiting for the capture of a deer". On another occasion he wrote that he saw "large numbers of waterfowl and also many Cranes, white as Swans, and other variety of birds like those in France". We can only speculate as to the identity of some of these species. There is some doubt as to whether Tundra Swans ever nested here but they probably did migrate through this region and we still see the occasional few. It is believed that the Trumpeter Swan may have nested here and recently an attempt to reintroduce them to southern Ontario is being made by using Mute Swans as foster parents (Lumsden 1985). The only white crane in North America is the Whooping Crane. Champlain mentioned white cranes in both his September and his October accounts. Although we cannot know surely whether they nested in this region before the forest was disturbed, it is possible that they commonly migrated through this area. On 27 September 1871, one was shot near Yarker, 32 km from Kingston, and is preserved as a mounted bird in the Biology Department of Queen's University. The only possible species in North America that could be mistaken for "Outardes", French for bustards, would be Wild Turkey. Although this species was known from southwestern Ontario from where they disappeared a few years before 1900, there are no records for this region (Baillie & Harrington 1936). It is interesting to speculate that Champlain might have seen turkeys here.

Both Blue-winged and Green-winged Teal nest here today. It is impossible to know which of our thrushes Champlain may have seen, although the Hermit Thrush is the most likely migrant in October. Our only true lark is the Horned Lark and this is a bird of open country and one would not expect to find it on his list. Common Snipe and Canada Goose both nest and migrate throughout Eastern Ontario.

Although this is such a short account, nevertheless one is left with the impression of very large numbers of birds. Champlain's stay here was during autumn migration with many birds returning to the south from their nesting season in the north, so he does not help us much in knowing what the forests contained in the way of breeding birds. By the time Captain Henry Hadfield was stationed in Kingston from late September 1857 to 28 May 1859, more than 200 years has passed. Now there was a small city with settled farms to the north and on the larger islands, and we have our first detailed account of the birds here. Hadfield was an amateur ornithologist who published his descriptions of the 93 species that he saw or collected during his stay in Kingston in three numbers of <u>The Zoologist</u> in 1857, 1859 and 1864. His descriptions are quite detailed and he gives some attention to population size of some of the species.

For further information we have to skip to the end of the 19th century to the Rev. C.J. Young who had a parish on Wolfe I. and who went for frequent bird walks and excursions. He was joined by a small band of enthusiastic birdwatchers who carried on well into the 1930's. We have diaries and accounts from these men to help with understanding the situation until 1949 when the Kingston Nature Club, now the Kingston Field Naturalists, came into being. Our founder, Dr. George M. Stirrett, instituted a system of record keeping which has been maintained to this day. This is augmented by annual breeding bird surveys, waterfowl counts, special counts at migration times, banding and the recent breeding bird atlas work. These have given us a firm base for evaluating the surprising number of changes in the makeup of our avifauna even for the 37 years these records cover and provide us with some understanding of the greater changes that would have come about during several centuries.

As is to be expected, the losses in the bird populations from the time of the earliest settlers to the present time have been serious. The Passenger Pigeon, as all are aware, was driven to extinction. Whether it was entirely because of market hunting or partly because of disease or even the loss of some of the beech forests or a combination of these, is still open to speculation. This region had its share of these beautiful birds and the enormous flocks are described by pioneers. An island in Lake Ontario, named Pigeon I., also testifies to their former presence here. The last account of a small breeding colony came from Kingston, 12 to 20 nests in 1898 (Mitchell 1935). Hadfield saw a few medium sized flocks in 1857-1859 but was disappointed not to have seen the large flocks about which he had been told. Spruce Grouse were extirpated in southern Ontario (Snyder 1957). Common Ravens retreated all along the north shore of Lake Ontario and, although occasionally single ones are now sighted here, they no longer breed within this region. We have small numbers of Pine Warblers nesting in the isolated clumps of White Pine that are the sole survivors of the extensive White Pine forests that existed here before they were cut to be used as masts for the tall ships of England. It would appear that the Pine Warbler may have been an exceedingly common warbler at one time but there are no records. Its small size and life high in the pines would have escaped the notice of the homesteaders. The last nest of the Piping Plover of which we have notice was of one on Collins Lake, only a few kilometres from Kingston, June 16, 1903 (Quilliam 1973). This bird was probably a fairly common nester on the sandy shores and beaches of the mainland and islands but this shy species is now found only in a few places on the Great Lakes.

While the above species were disappearing or becoming scarce, new species were arriving to take advantage of the open spaces, field and pastures. Most of these were from the prairies and they quickly began to invade the habitat that had now become suitable for them. They included such species as Eastern Meadowlark, Bobolink, Savannah Sparrow, Grasshopper Sparrow, Horned Lark, Brown-headed Cowbird, Common Grackle, and the very handsome Upland Sandpiper which thrives here now, particularly on Wolfe and Amherst Islands. We have a roughly estimated time of arrival for the Brown-headed Cowbird. Fothergill, an early writer on birds, living from 1817 to 1840 at Port Hope, about 200 km to the west of Kingston, did not mention its presence (Snyder 1957) but Hadfield (1864) found the "Cow Bunting" numerous around Kingston in 1857 and noted its parasitic habits. Its spread into Ontario may be linked to the disappearance of the large

herds of buffalo with which it associated on the western prairies. In this respect it should be noted that the Yellow Warbler, associated with a wide spectrum of open habitats, is known to cover with nesting material a cowbird egg laid in its nest, but that none of our other warblers, which are mostly woodland species, have developed such a defence. This leads one to believe that indeed the Brown-headed Cowbird is a relatively new arrival.

There are several species whose numbers decreased with the loss of the forest only to return again when the woodlands reached certain points in their development. So we find that Pileated Woodpeckers (Macoun 1909) were very scarce at the turn of this century. They need reasonably large tracts of trees old enough to provide them with food and nesting cavities. They were scarce during the early 1900's but began to increase as our present woodland began to mature. Another bird that was apparently rare right up to the early 1960's was the Red-tailed Hawk (Quilliam 1973). The increase has been dramatic and it is now our commonest buteo. It has found the combination of open fields and woodlots with tall trees ideal for nests and for food. Indigo Buntings would have been benefitted by the cycles of lumbering, since they would have taken advantage of the new emerging growth of shrubs and small trees. The Red-winged Blackbird and its extraordinary population growth has been much studied. It has been able to exploit the many types of habitat which our present landscape provides and mono culture also (e.g., large acreages in corn, etc.) has a bearing on its success.

Some gulls, particularly the Ring-billed, have thrived. It would appear that the Ring-bills could now go on increasing indefinitely except for a dearth of breeding places. Flat undisturbed islands at the east end of Lake Ontario support large nesting colonies. Some of the young gulls banded on Pigeon I. have turned up on the Leslie Street Spit, a long artificial spit created by landfill stretching into the lake near Toronto, since they had probably run out of room in this neighbourhood. This growth, which is also seen in the Herring Gull to a lesser extent, may be attributable to the ease with which the gulls find a food supply at garbage sites.

As a result of Canada's signing the Migratory Bird Treaty with the U.S. in 1916, some of the species that had been over-hunted began to increase once more. Common Terns taken for their feathers (Bent 1947), had almost disappeared, but in the 1930's they were again found to be breeding on some of the islands (Quilliam 1973). However, the increase was only temporary. A fairly substantial colony of about 120 nests on Pigeon Island in 1962 had disappeared by 1967, perhaps crowded out by the growing numbers of Ring-billed Gulls. We know of only one or two small colonies at present elsewhere. An amendment to the Treaty also provided protection for hawks and owls but despite this Bald Eagles were still being shot. Also pesticides, DDT and DDE, were causing eggshell thinning, thus inhibiting the reproductive success of eagles. Whereas in the early 1950's there were three nests from which young were fledged on Amherst and Wolfe Islands , and also in the Rideau Lakes country, no successful nest was found between 1957 and 1981. However, Ring-billed Gulls also affected by DDT and DDE, quickly responded to the cessation of the use of these chemicals. The Osprey seem not to have suffered here as much as in other parts of the continent.

The reasons for the decreasing numbers of Loggerhead Shrikes are unknown. Overgrown shrubby fields, particularly those containing hawthorns, seem to be preferred habitat. The KFN noted their numbers regularly in these fields and it was not until the late 1970's that their thinning numbers became evident. Some of this may have been allied to natural succession in some of the fields, but even where hawthorns still exist the Loggerheads are declining. It has also been suggested that a number of young may be killed by cars while hunting near highways. This species has been reported as showing signs of decrease in almost all parts of its range and has been placed on the National Audubon Society Blue List for 1981 (Tate 1981).

We have gained a number of introduced species - not all of which we welcome. Rock Doves seem to have arrived fairly early here but because they were originally domestic pigeons no one has paid much attention to when they became an integral part of our avifauna, but it must have been a fairly long time ago. They do not seem to have had any effect on our native birds but the Starling and the House Sparrow have. The House Sparrow was well established by the end of the century. It is found now around farms and barnyards and in cities where the pickings must be very meagre as compared with the age of horse drawn transport. They compete with the Eastern Bluebird and the Tree Swallow for the now scarce nesting sites. Nesting boxes put up by concerned citizens help to overcome this shortage.

The first notice we have of the European Starling here is of one taken on Wolfe I., in 1921 (Mousley 1926). In the space of 65 years, it has become our second commonest bird. It competes with the Northern Flicker for nest holes and, despite the large size of the Flicker, it is aggressive enough to be able to take over a nest hole from the Flicker. It is hard to know whether it is much of a threat to other species. The recent arrival of the House Finch, whose normal range extends in the west from British Columbia south into Mexico, is the result of a release of birds on Long Island, N.Y., in 1943. It has taken only 40 years for the House Finch to reach us here in Kingston where it has quickly established itself. It is rather amusing that the first nest found here was on a window ledge of the Biology Building at Queen's University in 1981. There is a possibility that it may present a challenge in the cities to the House Sparrow but seems to pose no threat to any of our native species.

Range expansion has added a considerable number of species to our list of breeding species here since the 1950's and 1960's. From the south, the Turkey Vulture, Northern Cardinal, Blue-gray Gnatcatcher and Golden-winged warbler are all well established, with more recent arrivals being Louisiana Waterthrush and Blue-winged Warbler. Although at least one nest of the Northern Mockingbird has been found, this species has been slow to become a regular breeder here. Carolina Wren, Tufted Titmouse, and Red-bellied Woodpecker occur almost every year but although breeding has been suspected in a number of cases, it has not been confirmed. They may all slowly become part of our avifauna if the present range expansions continue.

From the west we have received fewer species in recent times. A nesting colony of Wilson's Phalarope has become established on Amherst I. since 1980. Gadwall were not reported here until 1954, with the first nest in 1972, and Mallard

numbers have increased greatly. American Black Duck was formerly more common here than Mallard. The reasons for this change are not clear. Dickcissel, Western Meadowlark and Brewers' Blackbird are found occasionally but so far there has been no evidence of breeding.

The changes that have to do with range expansion may be the natural result of increasing populations necessitating a search for new territory. The very recent expansion of the Double-crested Cormorant is an excellent example of a population from both the west and the east filling in suitable territory. This might have happened much earlier but for the destruction of nests by fishermen who feared competition. Also pesticides caused some egg loss but those same pesticides and pollutants in Lake Ontario have had their affect on the fishing industry and, since about 1979, no longer being considered a threat to a much reduced fishing industry. colonies of cormorants on islands at the east end of Lake Ontario are growing rapidly.

There are a few activities of man that are beneficial, e.g., the supplying of feeding stations and nesting boxes, and the preservation of certain habitats. We have an excellent example of the spread of a species fostered by the use of feeders in winter. Evening Grosbeaks regularly irrupted into the east during the winter. With the increasing numbers of backyard feeders, Evening Grosbeaks have flocked to them during invasion years. After these invasion years some of the Grosbeaks began to nest farther east than the normal range. Now we have Evening Grosbeaks visiting almost every winter and the first nesting here confirmed. Feeding stations may also encourage some species not to migrate every winter, thereby increasing their chances of survival. For Eastern Bluebirds the provision of nesting boxes has been crucial and Purple Martins, Tree Swallows, American Kestrels, E.Screech-Owls and Wood ducks also benefit from them.

The recent enlightened attitude of more people toward the importance of our natural environment has led to a conscious preservation of various types of habitat. At all levels of government and in the private sector, there has been action in acquiring particularly sensitive areas for protection. Where we have lost within recent years some good habitat close to Kingston, we have also gained permanent protection for some.

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BIRD MIGRATION PATTERNS IN SOUTHERN ONTARIO

by Charles M. Francis

Abstract

Migratory passerines were quantitatively sampled using mist-nets at Prince Edward Point, Ontario, to determine the timing of spring and autumn migration. The duration of the main migration period for each species was about twice as long in autumn as it was in spring. Species that migrated very early in spring tended to migrate late in autumn. However, for species with later migration times there was no relationship between the average spring and autumn migration dates. This suggests that for most species, different factors influence the timing of spring and autumn migration.

Introduction

Few of the many species of birds breeding in Ontario remain throughout the year. Most species regularly migrate southwards in fall to wintering grounds in Central or South America and the southern United States. In spring, when the weather in the north improves and food becomes more abundant, they return to breed.

There is considerable variation among species in their timing of arrival and departure in southern Ontario. Some species, such as the American Robin or the Red-winged Blackbird, arrive as early as mid-March and do not depart until November (a few individuals even spend the winter). In contrast, species such as the Common Nighthawk arrive in early June and most have departed by late August (Sprague and Weir 1984). The majority of species, however, migrate north through southern Ontario in late April or May, and return south in August or September.

Little is known about why particular species migrate when they do. To try to understand the migration patterns, it is useful to quantify precisely the timing using an appropriate sampling method. Many different techniques have been developed to sample migratory birds, each with its own advantages and disadvantages. One of the more effective methods for sampling small passerines is systematic mist-netting. While netting results may be affected by weather patterns, they provide a relatively straightforward means of counting birds, particularly when birds are banded for individual recognition.

In this paper, I use the results of a program of regular mist-netting at Prince Edward Point Bird Observatory to describe the timing of migration for many of the more common passerines migrating through southern Ontario. I also compare the timing for different species, to try to learn more about why they migrate when they do.

Methods

The study area was located at Prince Edward Point, a promontory jutting into Lake Ontario about 30 km southwest of Kingston, Ontario, at 43° 57'N, 76° 54'W. Details of the habitat and netting areas are given by Weir et al. (1980).

Netting and banding of migratory birds was started by members of the Kingston Field Naturalists in 1975 but I have restricted my analyses to the period between 1976 and 1979 when the coverage was most consistent. During these years, nets were set irregularly in April, then daily from the beginning of May through the end of October, the period when most species were migrating. The number of nets in use varied slightly from day to day, but the netting effort was generally fairly evenly distributed over the season.

For the analysis, I pooled data from all four years to minimize fluctuations due to weather, variation in netting effort, and other factors. This approach increases slightly the variance in capture times, but nevertheless provides an index of the average long-term migration patterns. I did not correct the totals for net-hours, as the netting effort was reasonably uniform over each season, and the number of birds caught per net-hour varied depending on the location of each net, the weather, and the time of day, in addition to the number of birds actually present. Without detailed information on all of these factors, this correction could introduce more biases than it corrects.

I considered birds caught before 15 June to be on spring migration, and those caught after 15 July to be on autumn migration. Most birds caught between those dates were breeding at Prince Edward Point. To avoid confusion between summer residents and migrants, species which are common breeders around the netting area were excluded from the analyses. I further restricted the analysis to species with a total of at least 30 individuals caught in each season over the four years to minimize problems with small sample sizes.

Results and Discussion

The migration patterns for several typical species are shown in Figure 1. Preston (1966) suggested that bird migration patterns within each season should closely approximate a standard normal distribution. However, this was not true at Prince Edward Point, especially in autumn when the distributions of captures for many species were irregular with multiple peaks. Several factors could produce such distributions. Birds generally migrate in waves following weather fronts, so greater numbers will occur whenever weather conditions are most suitable (Richardson 1978). In addition, populations breeding in different areas are likely to arrive at Prince Edward Point at different times. There could also be differences among age/sex classes in the timing of migration (Gauthreaux 1982, Francis and Cooke 1986).

Autumn migration was more protracted than spring migration for most species. The period during which the middle 50% of the birds migrated (the mid-quartile range) was greater in autumn than in spring for 39 out of 45 species examined ($X^2 = 24.2$, $P < 0.01$). The mean ratio between the two was 2.3:1, indicating that the main autumn migration occurred over a period approximately twice as long as that for the spring migration.

The relative number of birds caught in each season varied considerably among species (Figure 1, Table 1). Overall, more birds might be expected in autumn than in spring, because the autumn migrants are supplemented by large numbers of immatures. This pattern was apparent for most species (33 out of 45; $X^2 = 9.8$, $P < 0.01$), but there were some striking exceptions. White-throated Sparrows and Wood Thrushes were caught in much greater numbers in spring than in autumn. In contrast, Tennessee Warblers and Hermit Thrushes were relatively scarce in spring but very common in autumn. These species may follow different routes on spring and autumn migration.

The median capture date varied among species significantly more in autumn than in spring ($F = 3.2$; $P < 0.01$). Nevertheless, there was a correlation between the median capture dates of each species in spring and in autumn (Figure 2; $r = -0.65$, $n = 46$, $P < 0.01$). Species that migrate relatively early in spring tend to migrate relatively late in autumn. However, a closer inspection of the relationship shows that it is not true for all species (Figure 2). Among species that migrate relatively late in spring, there was no apparent relationship between the spring and autumn migration dates. For example, among the paruline warblers, which are relatively common migrants later in spring, there was no correlation at all between spring and autumn dates ($r = -0.05$, $n = 19$, $P > 0.50$).

If climatic considerations were very important in determining migration times, then one would expect birds to migrate south in the reverse order from when they migrated north, producing a strong negative correlation between the migration dates. A similar correlation would also be expected if the distance to the breeding grounds (or from the wintering grounds) were the primary consideration. The tendency for some species to migrate very early in spring and very late in autumn suggests that one of these hypotheses may be partly true. For example, special adaptations may be required to tolerate the extreme weather experienced both in early spring and late autumn.

However, for other species, the weak correlation between spring and autumn migration patterns suggests that different factors influence the timing of autumn and spring migration. This may reflect differences in the motivation for migrating in each season. In spring, birds must return to the breeding grounds as soon as they are habitable to get a territory and nest. In contrast, the autumn migration is more leisurely, in that birds can migrate south any time before the food supply deteriorates. Species that are territorial on the wintering grounds may need to reach them much sooner than other species. The timing could also be influenced by the moult strategy of each species, or the number of broods reared in a season. A broader comparative study incorporating more variables is required to test these various hypotheses in an attempt to provide more answers to the question of why particular species migrate when they do.

Acknowledgements

Many members of the Kingston Field Naturalists helped with the bird-banding program at Prince Edward Point. C. S. Hirschey and the Canadian Wildlife Service gave permission to band birds in the area. Helen Quilliam deserves special thanks for entering all of the data onto the computer.

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See following pages for:

Table 1 - Median Dates of Capture, Spring and Autumn Migration, for Some Common Passerines at Prince Edward Point, Ontario
Figure 1 - Migration Patterns and Timing
Figure 2 - Relationship between Average Spring and Autumn Migration Dates

Table 1. Median dates of capture (with numbers caught) during spring and autumn migration for some common passerines at Prince Edward Point, Ontario.

Species	Season	
	Spring	Autumn
Eastern Kingbird	May 25 (45)	Aug 12 (159)
Great-crested Flycatcher	June 2 (69)	Aug 21 (196)
Eastern Wood-Pewee	May 31 (145)	Aug 28 (118)
Yellow-bellied Flycatcher	June 1 (186)	Aug 20 (200)
"Traill's" Flycatcher	May 31 (101)	Aug 17 (87)
Least Flycatcher	May 21 (404)	Aug 16 (835)
Blue Jay	May 14 (265)	Sep 30 (103)
Northern Oriole	May 19 (203)	Aug 11 (193)
White-throated Sparrow	May 9 (1429)	Sep 30 (441)
Chipping Sparrow	May 10 (76)	Aug 20 (59)
Dark-eyed Junco	Apr 23 (227)	Oct 14 (292)
Rose-breasted Grosbeak	May 17 (372)	Aug 20 (123)
Scarlet Tanager	May 18 (65)	Aug 25 (120)
Red-eyed Vireo	May 27 (426)	Aug 24 (902)
Philadelphia Vireo	May 27 (60)	Aug 20 (113)
Black-and-white Warbler	May 14 (123)	Aug 20 (231)
Nashville Warbler	May 14 (245)	Aug 31 (542)
Tennessee Warbler	May 21 (112)	Aug 21 (1082)
Cape May Warbler	May 20 (71)	Aug 26 (449)
Black-throated Blue Warbler	May 21 (123	Sep 16 (261)
Yellow-rumped Warbler	May 12 (832)	Sep 22 (1051)
Magnolia Warbler	May 23 (1018)	Aug 29 (1147)
Chestnut-sided Warbler	May 22 (156)	Aug 25 (260)
Bay-breasted Warbler	May 27 (200)	Aug 22 (1130)
Blackpoll Warbler	May 28 (39)	Sep 11 (494)
Blackburnian Warbler	May 28 (169)	Aug 21 (473)
Black-throated Green Warbler	May 21 (205)	Sep 3 (226)
Ovenbird	May 17 (150)	Aug 30 (256)
Northern Waterthrush	May 20 (51)	Aug 11 (190)
Mourning Warbler	May 29 (93)	Aug 20 (43)
Common Yellowthroat	May 21 (441)	Sep 14 (132)
Wilson's Warbler	May 24 (173)	Aug 28 (180)
Canada Warbler	May 26 (276)	Aug 20 (359)
American Redstart	May 25 (430)	Aug 27 (547)
Gray Catbird	May 21 (390)	Aug 20 (58)
Winter Wren	May 1 (52)	Oct 5 (127)
Brown Creeper	Apr 17 (327)	Oct 5 (558)
Red-breasted Nuthatch	May 20 (84)	Sep 27 (98)
Golden-crowned Kinglet	Apr 17 (51)	Oct 9 (628)
Ruby-crowned Kinglet	May 9 (356)	Oct 9 (1107)
Wood Thrush	May 17 (194)	Aug 8 (35)
Veery	May 18 (166)	Aug 25 (166)
Gray-cheeked Thrush	May 30 (53)	Sep 24 (151)
Swainson's Thrush	May 25 (615)	Sep 3 (973)
Hermit Thrush	May 6 (152)	Oct 10 (484)

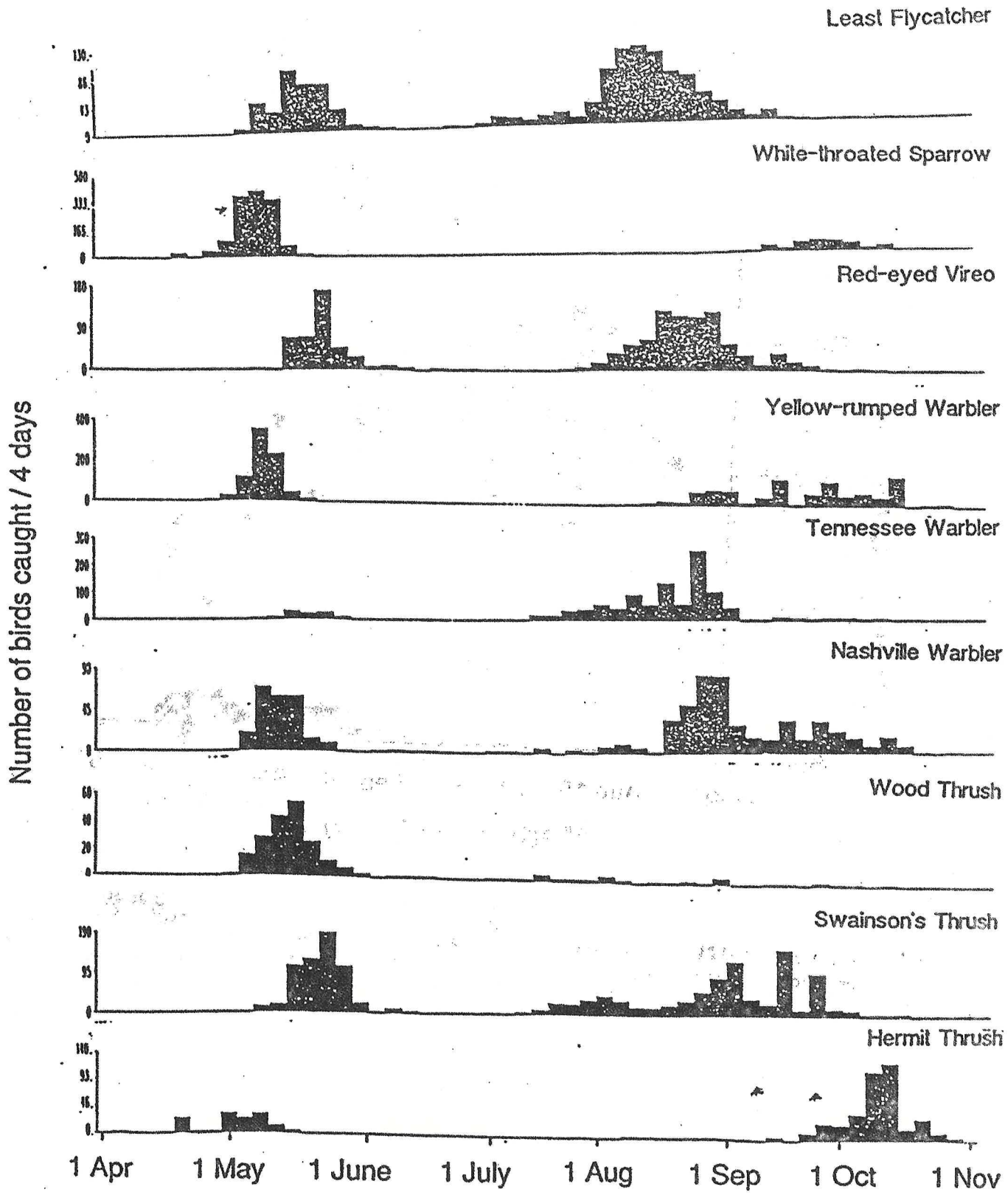

Figure 1. The migration patterns and timing for selected passerines migrating through Prince Edward Point, Ontario.

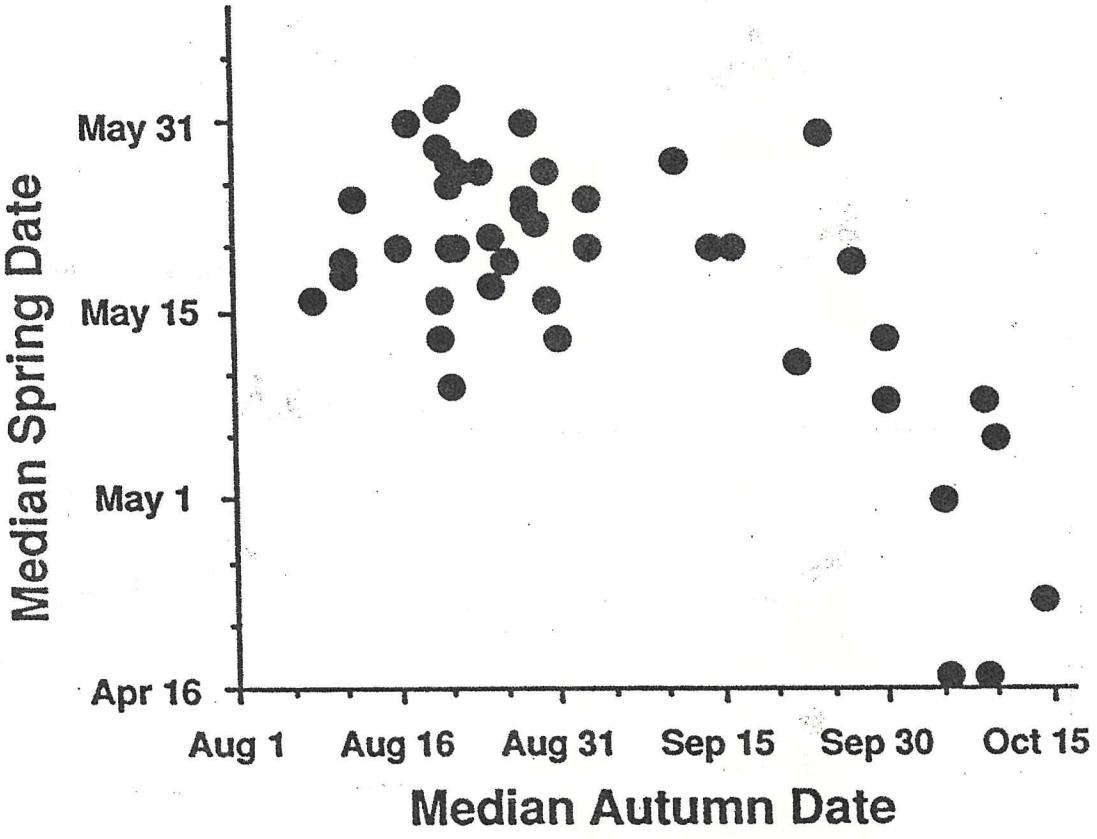

Figure 2. The relationship between average spring and autumn migration dates for some common passerines caught at Prince Edward Point, Ontario.

HAWKS AND OWLS OF THE KINGSTON REGION

by Frank Phelan

The mixed habitat area surrounding Kingston provides good opportunity for encounter with and study of many of the hawks and owls of Ontario. In this region, the birdwatcher could view in a year all of the owl and hawk species which occur in Ontario. Indeed, of Ontario's 11 owl species, 7 are found breeding in this area (Eastern Screech-Owl, Great Horned Owl, Long-eared Owl, Short-eared Owl, Barred Owl, Barn Owl, Saw-whet Owl). An even larger proportion of the 12 Ontario hawk species may be sighted while nesting, 8 species have been recorded breeding in the area (N.Goshawk, Cooper's Hawk, Sharp-shinned Hawk, N.Harrier, Red-tailed Hawk, Red-shouldered Hawk, Broad-winged Hawk and American Kestrel). The remainder of Ontario's owl and hawk species have been recorded as winter residents of the area or as migrants (Snowy Owl, N.Hawk Owl, Boreal Owl, Great Gray Owl, Rough-legged Hawk, Gyrfalcon, Peregrine Falcon, Merlin).

Of particular interest in the Kingston region is the periodic abundance of raptors during the winter. Kingston Christmas Bird Counts often show very high numbers of wintering raptors. Canadian Christmas Bird Counts demonstrate that at 3 to 4 year intervals, invasion of northern species, most notably the Snowy Owl and Rough-legged Hawk occur. High counts of wintering raptors in the Kingston area generally coincide with the large pattern of raptor invasion. Why is this favoured as a regular wintering area for raptors?

The Kingston area lies in the path of the traditional seasonal raptor migration routes. In both spring and fall, large numbers of migrants funnel through the area as they swing around or fly directly over the Great Lakes. In their annual traverse of the region, migrant raptors encounter large blocks of suitable habitat. The region is typified by a mosaic of open farmland, second-growth forest (most deciduous), marshes and small pockets of bog and other coniferous habitats. The large raptors which frequent open areas find extensive suitable habitat in the two large islands, Wolfe and Amherst, lying just off Kingston in Lake Ontario. Both of these islands are flat and open, heavily cultivated but with suitable perches and hedgerows and sizeable tracts of woodland readily available.

The presence of the lake surrounding the landmass of the islands provides a moderating influence on the extremes of climate. The islands are swept by southwest winds at most seasons. In winter, this aids in blowing snow from fields and piling it against windbreaks, keeping some ground exposed and making resident mice available to winged predators.

The two islands are characterized as supporting healthy meadow vole populations. Studies of numbers have shown peak population densities higher than many reported in other locations in North America. Large areas of suitable habitat, fertile soil, and moderate climatic conditions make the islands ideal for meadow voles and, hence, for raptors. It may be that confining of the meadow vole population to an island may limit dispersal from population centres. As population density of meadow voles typically cycles, islands often exhibit exaggerated cycles, with higher peaks than mainland areas, providing exceptionally attractive conditions for raptors.

Another interesting feature of the meadow vole populations on these two islands has emerged. It appears that the vole population cycles of the islands are out of phase with each other. Thus, when Wolfe I. vole population is high, that on Amherst is low, and vice versa. Hence the region will always afford wintering raptors at least one suitable area with abundant prey.

Some winters offer enthusiasts the opportunity to view great numbers of northern raptor species. For example, in the winter of 1978-79 on Amherst I., a daily count of owls could reach 160 individuals of 10 species, for the most part Great Grey Owls, Long-eared Owls and Snowy Owls. Visits to both of the islands rewarded members of one party with the 'grand-slam' of owling, all 11 Ontario species in a single day.

Kingston Field Naturalist records demonstrate the great numbers of raptors present on the islands. The following table for the years 1960-1979 show a sample of the number achieved by the most common wintering raptors, the Snowy Owl and Rough-legged Hawk.

Highest counts of Snowy Owls and Rough-legged Hawks on Amherst and Wolfe Islands
(from Kingston Field Naturalists' records)

Year	Amherst Island			Wolfe Island		
	Snowy Owl	Rough-legged Hawk	Total	Snowy Owl	Rough-legged Hawk	Total
1960	9	55*	64	13	45*	58e
1961	3*	10	13	4*	45	49
1962	-	-	-	5	1	6
1963	-	-	-	6	3	9
1964	1*	0*	1	46*	30*	76a,e
1965	0	1	1	3	1	4
1966	3	20	23	8	2	10
1967	1*	2*	3	16*	14*	30
1968	1	9	10	9	40	49e
1969	0	36	36	4	8	12
1970	1	3*	4	8	40*	48
1971	0*	1	1	85*	106	191be
1972	21	30	51c	4	14	18
1973	3	42	45	11	7	189
1974	1*	2*	3	69*	195*	264c,e
1975	4	14	18	8	2	10
1976	5	15	20	5	3	8
1977	1	1*	2	3	64*	67e
1978	21*	55	76d	6*	0	6
1979	1	9	10	18	9	27

- indicates no counts during period.

* peak raptor invasion years in eastern North America.

Peak vole densities: a - Quilliam, 1965. b - Weir, 1973. c - Phelan, 1976.
d - Bell *et al.*, 1979a,b. e - Kingston Field Naturalists.

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BIRDS OF EASTERN ONTARIO RELATIVE TO HABITAT

by Ron D. Weir

Familiarity with the avifauna of particular habitat types, coupled with a knowledge of where these habitat types occur within any region, is invaluable information to naturalists and birdwatchers. A visit to the appropriate habitat type at the correct time of year is needed to see the relevant species, subject of course to how rare the species is. To the conservationist, species management is achieved via habitat management, whether for nesting, wintering or staging during migration. The Kingston area contains a wide spectrum of habitat types not yet destroyed by urban sprawl that has taken place in many parts of the world. The following article is intended to give an overview of these types in eastern Ontario and those species which have been found therein. Records from the files of the Kingston Field Naturalists go back to 1949 and they constitute an important source of historical information of the changes in bird populations that have occurred here. Much of these data were gathered in systematic surveys and censuses at different times of the calendar year.

The area covered extends from Belleville in the west to Rockport in the east (Thousand Islands), a distance of about 150 km to include Prince Edward County, Wolfe and Amherst Islands. From the international boundary with the U.S., the area runs to Westport in the northeast and Kaladar and El Dorado in the west, a distance of about 120 km. This takes in Lake Ontario, parts of the St.Lawrence Lowlands and its forest, and extends into the Canadian Shield with its rugged granite outcroppings, many lakes and mixed forest.

METHOD

For the purposes of this survey, Eastern Ontario has been divided into nine habitat types and for each type the avifauna have been classified as to seasonal occurrence. The types and categories are defined as follows:

A. HABITAT TYPES

1. Open water - Lake Ontario, inland lakes and St. Lawrence River.
2. Marsh - cattails, bulrushes, sedge and grass with standing water.
3. Grassland - meadows, abandoned fields, pastureland, hayfields with or without fence rows, farm buildings.
4. Abandoned farmland - abandoned fields in succession to bushes and saplings, orchards, abandoned buildings.
5. Thickets - low bushes and vegetation along roads, railways and water courses.
6. Forest - deciduous, coniferous or mixed woodland with canopy.
7. Swamp - flooded woodland.
8. Shoreline - muddy or rocky edges of rivers, lakes, sewage ponds, embankments, breakwaters and bridges.
9. Urban - settled areas in villages, towns and cities.

B. SEASONAL OCCURRENCES

1. Permanent resident - normally present throughout the year, breeds locally.
2. Breeder - breeds locally, but is normally absent in autumn/winter.
3. Passage migrant - does not breed locally but only appears as a migrant in spring and autumn.
4. Winter visitor - does not breed locally but regularly spends the winter in the area, normally arriving in autumn and departing in spring.
5. Rare/very rare - does not breed locally but is seen once in a while, sometimes in numbers.

RESULTS AND DISCUSSION

Those species that occur in each of the 45 categories are shown in Table 1. It should be noted that a species may occur in more than one category so that the total 'species occurrences' of 766 exceed the 341 species currently in the KFN checklist.

Shown in Table 2 are the numbers of 'species occurrences' associated with each category. The percentage which each number represents in relation to the total is shown either beside or below that number. For example, associated with open water habitat there is a total of 68 'species occurrences' of which two are permanent residents - i.e., 3% (read horizontally). However, these two permanent residents in open water constitute 4% of the 49 permanent residents in all (read vertically).

A. HABITAT

1. Open water - some 37% of species occurring here are passage migrants, followed by 31% which are of accidental occurrence.

2. Marshes - Passage migrants at 49% make up the largest user group for this habitat, followed by breeders at 34%. More significant perhaps is the presence of at least 13 species in this habitat that either do not or cannot breed anywhere else. Hence marsh destruction has serious effects on these species.

A. HABITAT (cont'd)

3. Grassland - The largest user group is the breeder at 50% of the total species occurrences.

4. Abandoned farmland - This habitat is exploited most by the passage migrants (47%), followed by breeders (34%).

5. Thickets - Some 59% of the thicket users are passage migrants. This is not surprising as thickets offer immediate shelter, protection and food when the migrants are grounded.

6. Forest - At 125 species occurrences, this habitat type is exploited by the most species. The breeders make up 47% of these, which at 59 species occurrences is the most for any of the 45 categories.

7. Swamp - This habitat appears most important to the breeders which make up 63% of the users.

8. Shoreline - Passage migrants, mainly shorebirds and waterfowl, make up 46% of the users of this habitat, followed by the breeders at 35%.

9. Urban - This habitat is second only to forest for the numbers of users. Some 39% are passage migrants exploiting backyards, garden allotments, tree-lined streets and Conservation Authority green belt. This green belt is an unbroken strip on the west side of Kingston along the Little Cataraqui Creek. Experience elsewhere has shown that continuity of habitat is more effective in maintaining bird populations that isolated pockets of habitat.

B. SEASONAL USE

1. Permanent residents - Some 31% of these are forest dwelling, followed by 29% in urban habitat. Our harsh winters are ameliorated for many species by feeders put out in the settled areas.

2. Breeders - These are more evenly distributed among the nine habitat types than any other user. In all they make up 36% of all our 766 'species occurrences', which ties that for passage migrants.

3. Passage migrants - The most important habitat types for this group are marsh, abandoned farmland, urban areas and thickets.

4. Winter visitors - These number 71 or 9% of the total 'species occurrences'. The largest percentage of these (23%) exploit urban habitat, mainly feeding stations. Of course, the permanent residents are also present in winter and number 49, so that of the 120 total in that season, 49/120 - 41% are local breeders and 71/120 = 59% spend only winter here.

B. SEASONAL USE (cont'd)

5. Accidental or strays - These number 93 species occurrences, or 12% of the total. Of these, 21 or 23% occur in open water (waterfowl).

C. ACTUAL NUMBER OF SPECIES

The actual numbers of species present at three different times of the year are given in Table 3 for each year since 1966. Censuses are carried out annually in the third week of May, generally considered the optimum time for most numbers of species, the first weekend in November at the tail end of autumn migration, and in late December when winter's species are here. The average number for each of these three times is shown, along with the cumulative number of species. Almost three times the number of species is seen in May in comparison with December. These numbers continue to drop, reaching a minimum of 50-60 in late January. The annual species total for the region is given in the last column and 261 species are expected in an average year.

As a check on 'species occurrences' producing similar percentages as actual species numbers, the comparative data for winter visitors and permanent residents shown above in B. 4. are given here. Permanent residents number 26 species and winter visitors number 38 species for a total of 64. Hence local breeders in the wintering population amount to 26/64 = 41%, and winter visitors 38/64 = 59%, which are percentages identical to the numbers obtained using 'species occurrences'.

Of our raptor population, 11 of our 16 species breed locally as do 14 of our 30 species of waterfowl.

D. BREEDING SPECIES

The data above for the nine habitat types give no indication of how common any of the species are within our area. For the first time fairly accurate numbers of the breeding pairs are available, thanks to the five-year Ontario Breeding Bird Atlas project that was run from 1981-85. The 20 most common breeders are listed in Table 4, where the total numbers and the pairs per square are based upon 81 squares, each of which is 10 x 10 km in size. The two leading species breed in four of our nine habitat types and the number three species, American Robin, breeds in three habitat types. Numbers of breeding Red-winged Blackbirds have increased over the past several decades as habitat has been altered to more farmland and this species has adapted readily to nesting in grassland and abandoned farms in addition to the traditional marsh and swamp sites.

For the diurnal and nocturnal raptors, the breeding pair totals are presented in Table 5. Red-tailed Hawk and Great Horned Owl share the same habitat. The former hunts by day and the latter by night. That these two species lead the raptor totals reflects the substantial area of habitat available for hunting which consists of mainly dry woodland near agricultural land or other open areas. Red-shouldered Hawk and Barred Owl share wet forest and their numbers appear stable as habitat remains available to them. For the rarer species, Kingston lies at the northerly edge of the breeding range for Barn Owl, for

D. BREEDING SPECIES (cont'd)

which our cold winters and deep snow limit their numbers, and south of the range for breeding Merlin. The dearth of Peregrines is typical of their general decline in eastern North America as a result of ingested chemicals. The Bald Eagle pair that raised young here in 1981 was the first successful nest locally since the 1950's. Both pesticides and human disturbance are factors in its decline. Because of human disturbance, nest locations of our raptors are not disclosed. Turkey Vultures have increased dramatically here since the 1960's for reasons that appear not related to availability of habitat, a general trend within eastern North America.

E. WINTERING SPECIES

The Kingston area has become well known in North America as a centre for wintering owls, several species of which erupt at periodic intervals from the Arctic or northern boreal forests. The availability of suitable habitat with food supplies is the factor that entices these visitors to overwinter. The offshore islands, Wolfe and Amherst, are mainly agricultural and home to cycling populations of Meadow Voles *(Microtus pennsylvanicus)*, which can reach huge numbers at the peaks of their cycles in some winters. Whenever these peaks coincide with winter irruptions of owls, Snowy, Boreal, Hawk or Great Gray, these islands are havens for large numbers of the visiting raptors. The winter of 1978-79 and 1983-84 were the most recent for these invasions. Overwintering Snowy Owls have numbered 80 on Wolfe I., Borealis 3 to 5, and Hawk Owls 2 on Amherst I., and up to 100 Great Gray Owls on these islands plus woodlands surrounding the city of Kingston. Along with these owls are often numbers of Rough-legged Hawks, Red-tailed Hawks, American Kestrels and, rarely, Peregrine Falcons and Gyrfalcon.

F. PASSAGE MIGRANTS

The shallow portions of Lake Ontario along the shores of Wolfe and Amherst Islands and Prince Edward Point provide ideal habitat and food for large numbers of migrant waterfowl. During May and November, rafts of loons number 250, Horned Grebes 200, Greater Scaup 200,000, and White-winged Scoters several thousand. Eastern Lake Ontario is on the main flyway for scaup between the Atlantic seaboard and the Canadian Arctic.

A large fraction of the North American population of Brant passes through Kingston in May with numbers up to 50,000 birds, which may be 25% of their total population. Wild rice and other foods are available for them here.

As is the case for migrants anywhere in the world, habitat on their wintering grounds is essential to their survival as is habitat needed for nesting. Many of Kingston's breeding birds migrate well south into Central and South America where continued existence of certain habitats are not assured for the future. Upland Sandpiper winter in Patagonia, Chimney Swifts in Peru, Bobolinks in Brazil and Argentina, Mourning Warblers in Colombia and Blackpoll Warblers in Chile.

TABLE 1 SPECIES OCCURRING IN THE NINE HABITAT TYPES AT THE VARIOUS TIMES OF THE YEAR

Permanent Resident	Breeder	Passage Migrant	Winter Visitor	Rare/ Very Rare
OPEN WATER				
Mute Swan	Common Loon	Red-throated Loon	Harlequin Duck	Arctic Loon
Bald Eagle	Double-crested Cormorant	Common Loon	Oldsquaw	Eared Grebe
	Canada Goose	Horned Grebe	Common Goldeneye	Leach's Storm Petrel
	Common Merganser	Red-necked Grebe	Bufflehead	Northern Gannet
	Red-breasted Merganser	Tundra Swan	Common Merganser	American White Pelican
	Osprey	Snow Goose	Iceland Gull	Great Cormorant
	Ring-billed Gull	Brant	Glaucous Gull	Great White-fronted Goose
	Herring Gull	Canada Goose		Cinnamon Teal
	Greater Black-backed Gull	Canvasback		Common Eider
	Caspian Tern	Redhead		King Eider
	Common Tern	Ring-necked Duck		Barrow's Goldeneye
	Black Tern	Greater Scaup		Long-tailed Jaeger
	Belted Kingfisher	Lesser Scaup		Laughing Gull
		Black Scoter		Common Black-headed Gull
		Surf Scoter		Mew Gull
		White-winged Scoter		Lesser Black-backed Gull
		Red-breasted Merganser		Ivory Gull
		Ruddy Duck		Arctic Tern
		Pomarine Jaeger		Thick-billed Murre
		Parasitic Jaeger		Razorbill
		Franklin's Gull		Black Guillemot
		Little Gull		
		Bonaparte's Gull		
		Black-legged Kittiwake		
		Forster's Tern		
MARSHES				
Ring-nck Pheasant	Pied-billed Grebe	Ring-necked Duck	Snowy Owl	Great Egret
	American Bittern	Lesser Scaup	Downy Woodpecker	Snowy Egret
	Least Bittern	Merlin	Black capped Chickadee	Little Blue Heron
	Great Blue Heron	Peregrine Falcon	American Tree Sparrow	Tricolored Heron
	Green-backed Heron	Yellow-bell. Flycatcher		Yellow-crowned Night Heron
	Black capped Chickadee	Eastern Phoebe		Glossy Ibis
	Canada Goose	Eastern Kingbird		Wood Stork
	Green-winged Teal	Purple Martin		Eurasian Wigeon
	American Black Duck	Tree Swallow		Yellow Rail
	Mallard	N.Rough-winged Swallow		King Rail
	Northern Pintail	Bank Swallow		Purple Gallinule
	Blue-winged Teal	Cliff Swallow		Sharp-tailed Sparrow
	Northern Shoveler	Barn Swallow		Yellow-headed Blackbird
	Gadwall	Brown Creeper		

Permanent Resident	Breeder	Passage Migrant	Winter Visitor	Rare/ Very Rare
MARSHES (cont'd)				
	American Wigeon	Winter Wren		
	Northern Harrier	Marsh Wren		
	Virginia Rail	Golden-crnd. Kinglet		
	Sora	Ruby-crnd. Kinglet		
	Common Moorhen	Swainson's Thrush		
	American Coot	Hermit Thrush		
	Common Snipe	Gray Catbird		
	Wilson's Phalarope	Brown Thrasher		
	Black Tern	Water Pipit		
	Short-eared Owl	Philadelphia Vireo		
	Belted Kingfisher	Red-eyed Vireo		
	Alder Flycatcher	Tennessee Warbler		
	Sedge Wren	Orange-crowned W.		
	Marsh Wren	Nashville Warbler		
	Common Yellowthroat	Yellow Warbler		
	Song Sparrow	Chestnut-sided W.		
	Swamp Sparrow	Magnolia Warbler		
	Red-winged Blackbird	Black-throated Blue W.		
	Common Grackle	Yell.-rumped Warbler		
	Brown-headed Cowbird	Black-throated Green W.		
		Prairie Warbler		
		Palm Warbler		
		Bay-brsted.Warbler		
		Blackpoll Warbler		
		Black-and-White W.		
		American Redstart		
		N. Waterthrush		
		Connecticut Warbler		
		Mourning Warbler		
		Wilson's Warbler		
		Canada Warbler		
		Lincoln's Warbler		
		Wh.-throated Sparrow		
		Wh.-crowned Sparrow		
		Rusty Blackbird		
GRASSLAND				
Red-tld.Hawk	Mallard	Golden Eagle	Rough-legged Hawk	Cattle Egret
Ring-nkd.Pheasant	Blue-winged Teal	Bl.-bellied Plover	Gyrfalcon	Sharp-tailed Grouse
Gray Partridge	Northern Harrier	Lesser-Gldn. Plover	Snowy Owl	Sandhill Crane
Rock Dove	American Kestrel	Buff-brsted.Sandpiper	Horned Lark	Barn Owl
Mourning Dove	Killdeer	Water Pipit	Northern Shrike	Scissor-tail Flycatch
European Starling	Upland Sandpiper	Rusty Blackbird	Lapland Longspur	Dickcissel
House Sparrow	Screech Owl		Snow Bunting	Lark Sparrow
	Short-eared Owl		Common Redpoll	Harris' Sparrow
	Chimney Swift		Hoary Redpoll	Smith's Longspur

Permanent Resident	Breeder	Passage Migrant	Winter Visitor	Rare/ Very Rare
GRASSLAND (cont'd)	Red-headed Woodpecker		American Goldfinch	Chestnut-coll. Longs.
	Eastern Phoebe			Western Meadowlark
	Eastern Kingbird			Brewer's Blackbird
	Horned Lark			
	Purple Martin			
	Tree Swallow			
	Cliff Swallow			
	Barn Swallow			
	Eastern Bluebird			
	American Robin			
	Loggerhead Shrike			
	Gray Catbird			
	Northern Mockingbird			
	Brown Thrasher			
	Chipping Sparrow			
	Clay-colored Sparrow			
	Vesper Sparrow			
	Savannah Sparrow			
	Grasshopper Sparrow			
	Henslow's Sparrow			
THICKETS				
House Sparrow	Alder Flycatcher	Black-billed Cuckoo	Bohemian Waxwing	Carolina Wren
	Willow Flycatcher	Yellow-billed Cuckoo	Am. Tree Sparrow	White-eyed Vireo
	House Wren	Least Flycatcher	Purple Finch	Worm-eating Warbler
	Gray Catbird	Winter Wren		Louisiana Waterthrush
	Northern Mockingbird	Golden-crowned Kinglet		Kentucky Warbler
	Brown Thrasher	Ruby-crowned Kinglet		Connecticut Warbler
	Cedar Waxwing	Veery		Mourning Warbler
	Yellow Warbler	Gray-cheeked Thrush		Hooded Warbler
	Chestnut-sided W.	Swainson's Thrush		Yellow-breasted Chat
	Common Yellowthroat	Hermit Thrush		Blue Grosbeak
	Indigo Bunting	Wood Thrush		
	Rufous-sided Towhee	Solitary Vireo		
	Song Sparrow	Yellow-throated Vireo		
	Swamp Sparrow	Warbling Vireo		
	White-throated Sparrow	Philadelphia Vireo		
		Red-eyed Vireo		
		Blue-winged Warbler		
		Golden-winged W.		
		Tennessee Warbler		
		Orange-crowned W.		
		Nashville Warbler		
		Northern Parula		
		Magnolia Warbler		
		Cape May Warbler		
		Black-throated Blue W.		

Permanent Resident	Breeder	Passage Migrant	Winter Visitor	Rare/ Very Rare
THICKETS (cont'd)				
		Yellow-rumped W.		
		Black-throated Green W.		
		Blackburnian Warbler		
		Palm Warbler		
		Bay-breasted Warbler		
		Blackpoll Warbler		
		Black-and-White W.		
		American Redstart		
		Ovenbird		
		Northern Waterthrush		
		Wilson's Warbler		
		Canada Warbler		
		Field Sparrow		
		Fox Sparrow		
		Lincoln's Sparrow		
		White-cr. Sparrow		
		Dark-eyed Junco		
FOREST				
Northern Goshawk	Turkey Vulture	Merlin	N. Hawk Owl	Chuck-will's-widow
Red-tailed Hawk	Bald Eagle	Golden-crnd. Kinglet	Great Gray Owl	Red-bellied Woodpecker
Ruffed Grouse	Sharp-shinned Hawk	Ruby-crnd. Kinglet	Boreal Owl	Acadian Flycatcher
Wild Turkey	Cooper's Hawk	Gray-cheeked Thrush	Three-toed Wood.	Ash-thrtd. Flycatcher
E.Screech Owl	Red-shouldered Hawk	Swainson's Hawk	Black-bkd. Wood.	Western Kingbird
Great Horned Owl	Broad-winged Hawk	Solitary Vireo	Gray Jay	Gray Kingbird
Barred Owl	American Woodcock	Philadelphia Vireo	Boreal Chickadee	Blue-winged Warbler
Downy Woodpecker	Black-billed Cuckoo	Tennessee Warbler	Bohemian Waxwing	Hermit Warbler
Hairy Woodpecker	Yellow-billed Cuckoo	Orange-crowned Kinglet	Pine Grosbeak	Yellow-throated W.
Pileated Wood.	Long-eared Owl	Northern Parula	Red Crossbill	Kirtland's Warbler
Blue Jay	Saw-whet Owl	Magnolia Warbler	White-wg. Crossbill	Prothonotary Warbler
Common Raven	Common Nighthawk	Cape May Warbler	Pine Siskin	Worm-eating Warbler
Blk.-cap Chickadee	Whip-poor-will	Black-throated Blue W.	Evening Grosbeak	Kentucky Warbler
Wh.-brstd. Nuthatch	Ruby-thrtd. Hummingbird	Palm Warbler		Hooded Warbler
Am. Goldfinch	Red-headed Woodpecker	Bay-brsted. Warbler		Yellow-brstd. Chat
	Yell.-bellied Sapsucker	Blackpoll Warbler		Summer Tanager
	Northern Flicker	Connecticut Warbler		
	Least Flycatcher	Wilson's Warbler		
	Eastern Phoebe	Fox Sparrow		
	Great-crstd. Fycatcher	Lincoln's Sparrow		
	Eastern Kingbird	White-cr. Sparrow		
	Tree Swallow	Dark-eyed Junco		
	American Crow			
	Red-breasted Nuthatch			
	Brown Creeper			
	Winter Wren			
	Blue-gray Gnatcatcher			

Permanent Resident	Breeder	Passage Migrant	Winter Visitor	Rare/ Very Rare
FOREST (cont'd)				
	Veery			
	Hermit Thrush			
	Wood Thrush			
	American Robin			
	Cedar Waxwing			
	Yellow-throated Vireo			
	Warbling Vireo			
	Red-eyed Vireo			
	Golden-winged Warbler			
	Nashville Warbler			
	Yellow Warbler			
	Chestnut-sided W.			
	Yellow-rumped W.			
	Bl.-throated Green W.			
	Blackburnian Warbler			
	Pine Warbler			
	Prairie Warbler			
	Cerulean Warbler			
	Black-and-White W.			
	American Redstart			
	Ovenbird			
	Northern Waterthrush			
	Louisiana Waterthrush			
	Mourning Warbler			
	Canada Warbler			
	Scarlet Tanager			
	Rose-brstd. Grosbeak			
	Chipping Sparrow			
	White-throated Sp.			
	Brown-headed Cowbird			
	Northern Oriole			
	Purple Finch			
SWAMPS				
Downy Woodpecker	Pied-Billed Grebe	Olive-s.Flycatcher	Three-toed Wood.	Prothonotary Warbler
Hairy Woodpecker	Great Blue Heron	Rusty Blackbird	Blk.-bckd Wood.	
Pileated Wood.	Green-backed Heron		Bohemian Waxwing	
Blk.-cap Chickadee	Wood Duck		Pine Grosbeak	
Wh.-brstd.Nuthatch	Green-winged Teal		Pine Siskin	
	American Black Duck		Evening Grosbeak	
	Hooded Merganser			
	Osprey			
	Bald Eagle			
	Red-shouldered Hawk			
	American Woodcock			
	Barred Owl			

Permanent Resident	Breeder	Passage Migrant	Winter Visitor	Rare/ Very Rare
SWAMPS (cont'd)				
	Yell.-bell.Sapsucker			
	Tree Swallow			
	N.Rough-winged Swallow			
	Western Wren			
	Veery			
	Northern Waterthrush			
	Black-and-white Warbler			
	Common Yellowthroat			
	Canada Warbler			
	Swamp Sparrow			
	Red-winged Blackbird			
	Common Grackle			
	Brown-headed Cowbird			
SHORELINE				
	Dbl.-crst. Cormorant	Great Blue Heron	Iceland Gull	Great Cormorant
	Black-crwn. Night Heron	Canada Goose	Glaucous Gull	Eurasian Wigeon
	Canada Goose	Am. Black Duck	Lapland Longspur	Piping Plover
	Gr.-winged Teal	Mallard	Snow Bunting	American Avocet
	Am. Black Duck	Merlin		Willet
	Mallard	Peregrine Falcon		Marbled Godwit
	Northern Pintail	American Coot		Curlew Sandpiper
	Blue-winged Teal	Semi-palmated Plover		Franklin's Gull
	Northern Shoveler	Greater Yellowlegs		Common Bl.-hd. Gull
	Gadwall	Lesser Yellowlegs		Lesser Bl.-bk. Gull
	American Wigeon	Solitary Sandpiper		Common Raven
	Killdeer	Spotted Sandpiper		
	Common Snipe	Whimbrel		
	Wilson's Phalarope	Hudsonian Godwit		
	Ring-billed Gull	Ruddy Turnstone		
	Herring Gull	Red Knot		
	Gr.Black-backed Gull	Sanderling		
	Caspian Tern	Semipalmated Sand.		
	Common Tern	Western Sandpiper		
	Black Tern	Least Sandpiper		
	Belted Kingfisher	White-rumped Sandpiper		
	Eastern Phoebe	Baird's Sandpiper		
	Tree Swallow	Pectoral Sandpiper		
	N.Rough-winged Swallow	Purple Sandpiper		
	Bank Swallow	Dunlin		
	Cliff Swallow	Stilt Sandpiper		
	Barn Swallow	Ruff		
		Short-billed Dowitcher		
		Long-billed Dowitcher		
		Red-necked Phalarope		
		Red Phalarope		

Permanent Resident	Breeder	Passage Migrant	Winter Visitor	Rare/ Very Rare
SHORELINE (cont'd)		Little Gull		
		Bonaparte's Gull		
		Forster's Tern		
		Common Crow		
		Water Pipit		
URBAN				
Rock Dove	Mallard	Brown Creeper	Tufted Titmouse	Brewer's Blackbird
E.Screech Owl	Bl.-winged Teal	Winter Wren	Carolina Wren	Orchard Oriole
Great Horned Owl	American Kestrel	Golden-crnd.Kinglet	Bohemian Waxwing	
Downy Woodpecker	Killdeer	Ruby-crnd.Kinglet	Northern Shrike	
Hairy Woodpecker	Mourning Dove	Blue-gray Gnatcatcher	Am. Tree Sparrow	
Blue Jay	Common Nighthawk	Eastern Bluebird	Wh.-thrtd. Sparrow	
Blk.-cap.Chickadee	Chimney Swift	Veery	Dark-eyed Junco	
Wh.-brstd.Nuthatch	Ruby-thrtd.Hummingbird	Gray-cheeked Thrush	Redwinged Blackbird	
N. Mockingbird	N. Flicker	Swainson's Thrush	Pine Grosbeak	
European Starling	E. Wood Pewee	Hermit Thrush	Purple Finch	
N. Cardinal	Eastern Kingbird	Wood Thrush	Red Crossbill	
House Finch	Horned Lark	Solitary Vireo	Wh.-winged Crossbill	
Am. Goldfinch	Purple Martin	Yell.-thrtd. Vireo	Common Redpoll	
House Sparrow	Tree Swallow	Philadelphia Vireo	Hoary Redpoll	
	N.Rough-winged Sw.	Tennessee Warbler	Pine Siskin	
	Bank Swallow	Nashville Warbler	Evening Grosbeak	
	Cliff Swallow	Northern Parula		
	Barn Swallow	Chestnut-sided W.		
	American Crow	Magnolia Warbler		
	House Wren	Cape May Warbler		
	American Robin	Bl.-thrtd. Blue W.		
	Gray Catbird	Yell.-rumped W.		
	Brown Thrasher	Blk.-thrtd. Green W.		
	Cedar Waxwing	Blackburnian Warbler		
	Warbling Vireo	Palm Warbler		
	Red-eyed Vireo	Bay-brsted. Warbler		
	Yellow Warbler	Blackpoll Warbler		
	Pine Warbler	Black-and-White W.		
	Common Yellowthroat	American Redstart		
	Chipping Sparrow	Ovenbird		
	Savannah Sparrow	Northern Waterthrush		
	Song Sparrow	Connecticut Warbler		
	Eastern Meadowlark	Mourning Warbler		
	Common Grackle	Wilson's Warbler		
	Brown-hd. Cowbird	Canada Warbler		
	Northern Oriole	Scarlet Tanager		
		Rose-brsted. Grosbeak		
		Rufous-sided Towhee		
		Field Sparrow		

Permanent Resident	Breeder	Passage Migrant	Winter Visitor	Rare/ Very Rare
URBAN (cont'd)				
		Fox Sparrow		
		Lincoln's Sparrow		
		Swamp Sparrow		
		Wh.-crwn. Sparrow		
		Rusty Sparrow		

TABLE 2. NUMBERS OF SPECIES OCCURRENCES IN THE VARIOUS HABITAT TYPES

	Permanent Resident	Breeder	Passage Migrant	Winter Visitor	Accidental Stray	Total
Open Water	*2(3%) (4%)	13(19%) (5%)	25(37%) (9%)	7(10%) (10%)	21(31%) (23%)	68 (9%)
Marsh	1(1%) (2%)	34(34%) (12%)	49(49%) (18%)	4(1%) (6%)	13(13%) (14%)	101 (13%)
Grassland	7(10%) (14%)	35(50%) (13%)	6(9%) (2%)	10(14%) (14%)	12(17%) (13%)	70 (9%)
Abandoned Farm	4(4%) (8%)	35(34%) (13%)	48(47%) (18%)	8(8%) (11%)	7(7%) (8%)	102 (13%)
Thickets	1(1%) (2%)	15(21%) (5%)	42(59%) (15%)	3(4%) (4%)	10(14%) (11%)	71 (9%)
Forest	15(12%) (31%)	59(47%) (21%)	22(18%) (8%)	13(10%) (18%)	16(13%) (17%)	125 (16%)
Swamp	5(13%) (10%)	25(64%) (9%)	2(5%) (1%)	6(15%) (8%)	1(3%) (1%)	39 (5%)
Shoreline	- -	27(35%) (10%)	36(46%) (13%)	4(5%) (6%)	11(14%) (12%)	78 (10%)
Urban	14(13%) (29%)	36(32%) (13%)	44(39%) (16%)	16(14%) (23%)	2(2% (2%)	112 (15%)
	49(6%)	279(36%)	274(36%)	71(9%)	93(12%)	766

* Two species in this category amount to 2/68 = 3% (read horizontally) of the 68 associated with open water, and to 2/49 = 4% (read vertically) of the 49 permanent residents to associated with open water.

TABLE 3. NUMBER OF SPECIES ANNUALLY BETWEEN 1966-85 RECORDED AT THREE DIFFERENT TIMES OF THE YEAR AND THE YEARLY TOTAL.

Year	3rd weekend May	1st weekend Nov.	3rd weekend Dec.	Year's Total
1966	163	71	58	235
1967	182	58	58	229
1968	176	77	49	244
1969	173	88	66	246
1970	174	118	73	249
1971	169	103	73	247
1972	168	117	83	257
1973	195	99	76	263
1974	204	97	81	262
1975	196	113	79	263
1976	210	120	83	269
1977	196	113	89	266
1978	202	93	60	262
1979	181	117	86	264
1980	190	126	74	278
1981	200	103	69	277
1982	191	120	77	277
1983	200	123	87	279
1984	200	116	85	285
1985	199	115	85	272
Average Cumulative	189	104	75	261
TOTAL	266	204	141	341

TABLE 4. ESTIMATED NUMBER OF BREEDING PAIRS PER YEAR 1981-85 FOR THE 20 COMMONEST SPECIES IN THE KINGSTON REGION (81 SQUARES, EACH 10 X 10 KM).

		Total Pairs	Pairs per Square
1.	Red-winged Blackbird	193,500	2,389
2.	Song Sparrow	129,400	1,599
3.	American Robin	125,000	1,543
4.	Common Yellowthroat	57,200	706
5.	Common Grackle	56,400	696
6.	Yellow Warbler	55,000	679
7.	European Starling	54,800	677
8.	Red-eyed Vireo	51,800	640
9.	Tree Swallow	51,400	635
10.	Chipping Sparrow	46,900	579
11.	Barn Swallow	31,200	385

TABLE 4 ESTIMATED NUMBER OF BREEDING PAIRS PER YEAR 1981-85 FOR THE 20 COMMONEST SPECIES (cont'd)

		Total Pairs	Pairs per Square
12.	American Goldfinch	27,850	344
13.	Warbling Vireo	27,500	340
14.	Indigo Bunting	22,950	283
15.	Rose-breasted Grosbeak	21,200	262
16.	Bobolink	20,900	258
17.	Ovenbird	20,575	254
18.	Swamp Sparrow	15,500	191
19.	Savannah Sparrow	13,300	164
20.	Gray Catbird	10,600	131

TABLE 5. ESTIMATED NUMBER OF BREEDING PAIRS PER YEAR, 1981-85, FOR RAPTORS IN THE KINGSTON REGION

1.	Turkey Vulture	190	
2.	Osprey	52	
3.	Bald Eagle	4	
4.	Northern Harrier	200	
5.	Sharp-shinned Hawk	55	
6.	Cooper's Hawk	26	
7.	Northern Goshawk	35	
8.	Red-shouldered Hawk	270	
9.	Broad-winged Hawk	300	
10.	Red-tailed Hawk	630	
11.	American Kestrel	600	
12.	Merlin	1	(nesting not confirmed)
13.	Peregrine Falcon	1	(nesting not confirmed)
14.	Common Barn Owl	1	(nesting not confirmed)
15.	Eastern Screech-Owl	275	
16.	Great Horned Owl	815	
17.	Barred Owl	110	
18.	Long-eared Owl	51	
19.	Short-eared Owl	45	
20.	Northern Saw-whet Owl	200	

GEOLOGY OF EASTERN ONTARIO

by Mabel Corlett

Introduction

The Eastern Ontario area has had a complicated and interesting geological history, resulting in the formation and exposure of a variety of rocks and unconsolidated material (Figure 1). One immediate result of this variety is that many small, quasi-independent environments may now develop simultaneously within a geographically restricted area. From another perspective, the local abundance of geological evidence eventually allowed us to develop and test hypotheses about the earth's history in general, and to make some predictions about the future effect of physical, chemical and biological processes active today. The beginning to this exploration of the past and the future is the description and analysis of the present geological evidence. This study will start with the oldest rocks in the area, forming that southeasterly extension of the Precambrian Shield known as the Frontenac Axis, move to the flat-lying Paleozoic sedimentary rocks flanking the axis to the east and to the west, and end with a consideration of the unevenly distributed overlying unconsolidated materials. The geological processes which resulted in this array of evidence will be briefly described as their products are encountered.

Rocks of the Precambrian Shield

In general, shield areas contain the oldest rocks in the world; one sample from Greenland and one from Africa have radiometric dates of 3.8 billion years. Nearly all the rocks exposed in shields, however, have experienced elevated temperatures and pressures at one or more periods in their long history subsequent to their original consolidation. These conditions often arose because of their burial under great thicknesses of other rocks, usually during an orogenic (mountain-building) event. As a result the buried rocks may have recrystallized while still remaining solid (producing metamorphic rocks) or may have melted and then crystallized upon cooling (producing igneous rocks). An important side-effect of the elevated temperatures to which they have been subjected is that the quantitative record of their original pre-burial ages is largely obliterated; the common mineralogical radiometric clocks have been reset. Thus, one can put a minimum age on rocks involved in orogenic events- that of the orogenic event itself - but must recognize that the material examined usually has a prehistory, the length and details of which can now only be inferred.

In Eastern Ontario, the major resetting event took place (or rather reached its peak conditions) about 955 million years ago. This event is named the Grenville Orogeny and it affected all the North American continental rocks already in place in the area southeast of a line from the north shore of Lake Huron to the middle of the Labrador Atlantic coast. The material involved included large volumes of sediments, partially derived by erosion of the older Southern and Superior Province rocks (mean orogenic ages 1650 and 2480 million years respectively) to the northwest, and partially produced on the submerged coastal

platforms of those provinces by chemical or biochemical processes. Also affected were volcanic and other igneous materials often genetically related to the preliminary episodes of the Grenville Orogeny. The principal rock types which were formed in the Eastern Ontario area are shown in Table I, as are their most likely precursor rocks.

The maximum depth of burial of the Grenvillian-age rocks we now see at the surface can be estimated (from the temperatures and pressures required for laboratory duplication of critical minerals, or from thermodynamic data) at 20 km. The rocks were easily deformed under these conditions, and some exceedingly complex structures were developed. As a result, what we can study now in Eastern Ontario are, usually, folded, faulted, discontinuous fragments. Nevertheless, there is a general northeasterly extension to the units, and this directional trend of rocks with quite different erosional susceptibilities, established in Precambrian time, has affected many subsequent geological and present-day processes.

These oldest local rocks were intruded by later igneous bodies, commonly diabase and andesite dykes. These appear unaffected by metamorphism, and thus are thought to be considerably younger than 955 million years. The majority are usually assigned a late Precambrian age (ca 600 million years).

The First Profound Unconformity

As mentioned above, 955 million years ago the local Grenvillian-age rocks were at depths approaching 20 km; they represent the root zone of an ancient mountain range similar to, but considerably older than, the Appalachian range to the southeast. Yet now, immediately on top of this root zone, are observed predominantly flat-lying undeformed sedimentary rocks which, by analogy with present-day sedimentation processes, must have formed from water-laid sedimentary deposits at the surface of the earth. In the interval from 955 million years to the time of deposition of these sediments, therefore, a minimum of 20 km of covering rock must have been removed by the slow, inexorable processes of weathering, erosion, and accompanying isostatic uplift. Knowledge of the slow rate of such geological processes allows one to appreciate the enormity of this gap in the geological record -- it was a geological "Dark Age", illuminated, so to speak, only by a few igneous intrusions.

In general, any surface which provides evidence of a period of non-deposition in the geological record is called an unconformity. The magnitude of the gap here documented allows the term "profound", and the many magnificent examples of this profound unconformity are among the geological treasures of this area.

The Holleford Crater

Just prior to the Paleozoic inundation of Eastern Ontario, a remarkable incident took place -- namely, a meteor collision, producing a crater about 2 km in diameter. The collision can be dated rather accurately, since the surface rocks it affected were subsequently little eroded (drilling has revealed a thin talus covering over the impact breccia) and are directly overlain by the oldest Paleozoic strata of the region.

This crater, near the hamlet of Holleford (30 km northwest of Kingston), was the first meteor impact crater to be identified by systematic examination of air photographs. The tell-tale circular pattern can also be seen on large-scale topographic maps; the covering Paleozoic strata dip gently in toward the centre of the crater, as does the topographic surface, and the centre itself is a shallow swamp.

Paleozoic Sedimentary Rocks

The sedimentary rocks overlying the Precambrian basement are assigned, on the basis of their fossil remains here or elsewhere, to the early Paleozoic Era (575 - 465 million years old). The specific nature and accepted nomenclature depend on their location to the east or the west of the Frontenac Axis; the formational names used here are those of the western margin, and generally conform to the usage of Liberty (1967).

The oldest strata, Cambrian in age, are named the Potsdam Formation. They often contain particularly in their lower units, large cobbles and boulders of recognizable Precambrian rocks. The presence of these rough fragments is indicative of the topographic relief that must have existed at the time of deposition, with Precambrian hills composed of quartz-rich erosion-resistant rocks contributing their coarse erosional debris to the sediments already accumulating in the valleys. The topography shown by the Precambrian terrane in the Paleozoic Era, in fact, must have been remarkably similar to that existing in the same terrane today and must have been similarly dominated by northeast-trending, structurally controlled features.

These cobbles and boulders commonly form sub-horizontal to horizontal layers within the dominant red and white to buff-coloured quartz sandstones and siltstones; this is suggestive, again by analogy with present-day sedimentation processes, of changeable velocity (and therefore competence) in the transporting fluid.

An unusual feature in some sandstone outcrops is the presence of vertical cylindrical concretions; their origin has not been definitely established, although it has been suggested that they represent former potholes in the sandstone. The most dramatic occurrence is just southeast of Joyceville on the Cataraqui River (Park of Pillars, Hughes Road).

There may be a minor unconformity established between the Potsdam Formation and the overlying Ordovician-age sedimentary rocks. The Ordovician rocks, however, are often found lapping directly on to the Precambrian terrane, indicating that change in relative sea level since Cambrian time had allowed formerly exposed land surface to be inundated. Particularly in these areas the oldest units, lying directly on the Precambrian surface, are commonly medium-grained quartz-rich conglomerates with a characteristic green, calcareous matrix. They have been named the Rideau beds (Baker, 1916), and are considered to be the lowermost Ordovician formation in the area. There follows a sequence dominated by red and green shales (the Shadow Lake Formation). These poorly consolidated, fissile units are easily weathered, and frequently create overhangs. They follow the thick-bedded limestones, dolostones and minor shales of the Gull River,

Bobcaygeon and Verulam Formations. The carbonate members of the Gull RIver Formation were important building stones in this area, particularly in the nineteenth century. Their exploitation has since become uneconomical, and Kingston, "The Limestone City", now builds its limestone buildings with stone from Queenston!

Younger sedimentary rocks occur both farther east and farther west of the Kingston area; in the part of Eastern Ontario immediately adjacent to Kingston, however, the consolidated rock record normally ends with these Middle Ordovician formations (ca 500 million years old). The lack of major dislocations and deformations in the Paleozoic sedimentary rocks indicates that local conditions have been relatively stable since the beginning of their deposition (575 million years ago) and that the area has been influenced since then primarily by surficial geological processes.

Paleozoic and Mesozoic Intrusive Rocks

A few instances have been recorded in Eastern Ontario of intrusive rocks which, because of their field relations or their radiometric ages, must be assigned a post-Cambrian age. Documented occurrences are near Mallorytown (ca 410 million years), Wolfe Lake (340 million years), Picton (175 million years) and Varty Lake (170 million years) (Hon, 1970; Barnett et al., 1984). It may be that systematic sampling and age determination will identify other young intrusive bodies; at the moment, however, they must be regarded as rare in this area.

The Second Profound Unconformity

The general absence of younger consolidated rocks defines the lower surface of a second profound unconformity; between the Middle Ordovician rocks and the unconsolidated Quaternary glacial deposits which currently form the upper surface of the unconformity lies a nearly complete gap in the rock record of approximately 500 million years. If this area once more becomes a site for sedimentary rock formation, the resulting units will fit reasonably smoothly on to the underlying Ordovician rocks (producing an unobtrusive variety of unconformity called a disconformity), and the immense gap in the geological column will become invisible to all but the most discerning future observer. That observer will recognize, by comparison of the fossil contents above and below the unconformity with more complete records elsewhere, that a very long period of erosion or, at a minimum, non-deposition, is represented by the thin surface of the disconformity.

Quaternary Geology

If one were given an hour to outline the geological history of the earth, and were required to divide that hour among various eras, periods, and epochs in proportion to the length of time they represent in that history, then the description of Precambrian time would take the first 53 minutes. Paleozoic and Mexozoic Eras and the Tertiary Period together would bring the elapsed time to 59 minutes, 58.2 seconds, leaving the last 1.8 seconds of the hour for a description of the Quaternary Period.

The events of the Quaternary Period, however, have had the most obvious impact on our current landscape, and thus merit a somewhat lengthier examination. Moreover, we have a relatively greater proportion of evidence available to solve the problems of this most recent geological period, and these data form the basis for our understanding of geological processes; the fundamental principle of geology is that the present is the key to the past.

During most of the last 2.5 million years, this area has been subjected to periodic episodes of continental glaciation. It is difficult to trace the sequence of early ice advances and retreats, however, since each successive advance tended to rearrange the unconsolidated material left from the previous episodes. The most fully documented glaciation in Eastern Ontario was therefore the last one which affected this area, and also the one which appears to have had the most profound effect on our present-day landscape. This was the last episode of the Classical (or Late) Wisconsin Glaciation, reaching its maximum extent about 20,000 years ago, and retreating from the Kingston area about 12,000 years ago, although its influence continued to dominate local surficial processes for another 3000 years.

Glacial advance is well documented by the common striations, grooves, and chatter marks (crescent-shaped gouges) on bare bedrock surfaces. The orientation of these erosional features testifies to a general southwestward advance of the ice in this area, as the orientation of the hills and valleys of the Precambrian terrane helped determine the direction of glacial flow. The unconsolidated material which had previously mantled the bedrock was generally incorporated in the bottom ice and carried forward with continuing glacial movement.

The terminal moraines, marking the furthest advance of the ice sheet, are located 200 to 400 km south of Kingston. In the local area till sheets and occasional recessional moraines can be found, formed by direct deposition from the melting glaciers with at most minor flucial reworking and sorting.

The weight of the ice sheet caused significant depressions of the land surface which still persist to a small extent. Once the glaciers retreated slightly northward, these irregular depressions allowed melt water to accumulate in glacial lakes near the margin of the glaciers (Fig. 2a); much of Eastern Ontario was submerged under glacial Lake Iroquois which in its early stages drained southeastward through the Mohawk-Hudson River system. Later drainage was established through the present-day Lake Champlain area (fig. 2b); once the St. Lawrence Valley became free of ice, the present drainage of Lake Ontario was established (Fig. 2c).

The resultant fluvial and lake deposits consist of well-sorted sands, silts, and clays; deltaic deposits are common, and varved clay deposits and dropstones incorporated in finer sediments are evidence of the glacial nature and consequent annual freezing-over of these lakes. Many of the deposits have been quarried; those at Sand Hill (Highway 15, 25 km north of Kingston) and Gananoque (Highway 32, 1 km north of Highway 401) are easily accessible. An interesting side note at Gananoque is the presence of numerous swallow holes in the quarry walls; they are invariably located in the higher-strength clay horizons, rather than in sandy or silty layers, by these instinctive "civil engineers".

Removal of the last ice dam on the St. Lawrence River allowed substantial marine transgression on to the depressed continental platform. Deposits from the Champlain sea can be found as far west as Brockville in the St. Lawrence Valley and Petawawa in the Ottawa Valley. They consist of stratified terrigenous sands, silts, and clays; one prominent Champlain Sea clay unit is remarkable for its precipitous loss of strength when saturated with water; this property has resulted in dramatic landslides in Eastern Ontario (South Nation River) and Quebec (St.Jean-Vianney).

Till and glacial lake and sea deposits form a transported overburden; as a result, the soil over much of the area bears little compositional affinity to the underlying bedrock. The primary regions where the chemical nature of the bedrock most affects the local environment are those in which this transported overburden is scanty or lacking. Also since the distribution of the glacial tills and glacial lake and sea deposits is influenced by glacial rather than fluvial processes, their deposition has produced a disruption of normal drainage patterns which remains evident today.

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TABLE 1

MAJOR ROCK TYPES ASSOCIATED WITH THE GRENVILLE OROGENY IN EASTERN ONTARIO

NAME	ORIGINAL ROCK	REMARKS
I. IGNEOUS ROCKS		
Granite, Syenite Pegmatite	Various silica-rich rocks, both sedimentary and igneous	Heating of many common rock compositions(containing Si Al, K, Na, Ca Fe, Mg, O, H20) will produce, as the first molten material, a granitic/syenitic composition.
Diorite, Gabbro	Older Diorite, Gabbro, Basalt, Si-poor igneous rocks	These are minor in volume compared to granite/syenite/ pegmatite.
II. METAMORPHIC ROCKS		
Marble	Limestone, Dolostone	Major mineral composition is unchanged; calcite, dolomite are recrystallized. Impurities may form new metamorphic minerals.
Quartzite	Sandstone	Major mineral remains quartz (recrystallized or overgrown).
Gneiss, Schist	Shales, etc. Also original igneous rock (granite, gabbro, basalt, etc.)	Schists and gneisses both show new planar features due to recrystallization during metamorphism. Gneisses also show compositional layering.
Amphibolite	Gabbro, Basalt	Major minerals are amphibole and plagioclase feldspar.

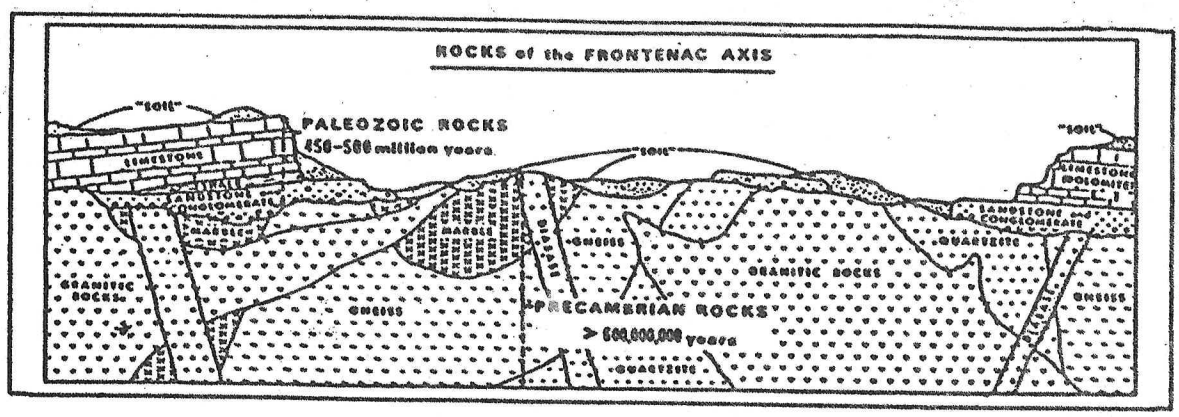


Figure 1. Generalized geological cross section across the Frontenac Axis. A.W. Joliffe, Queen's University, 1973.

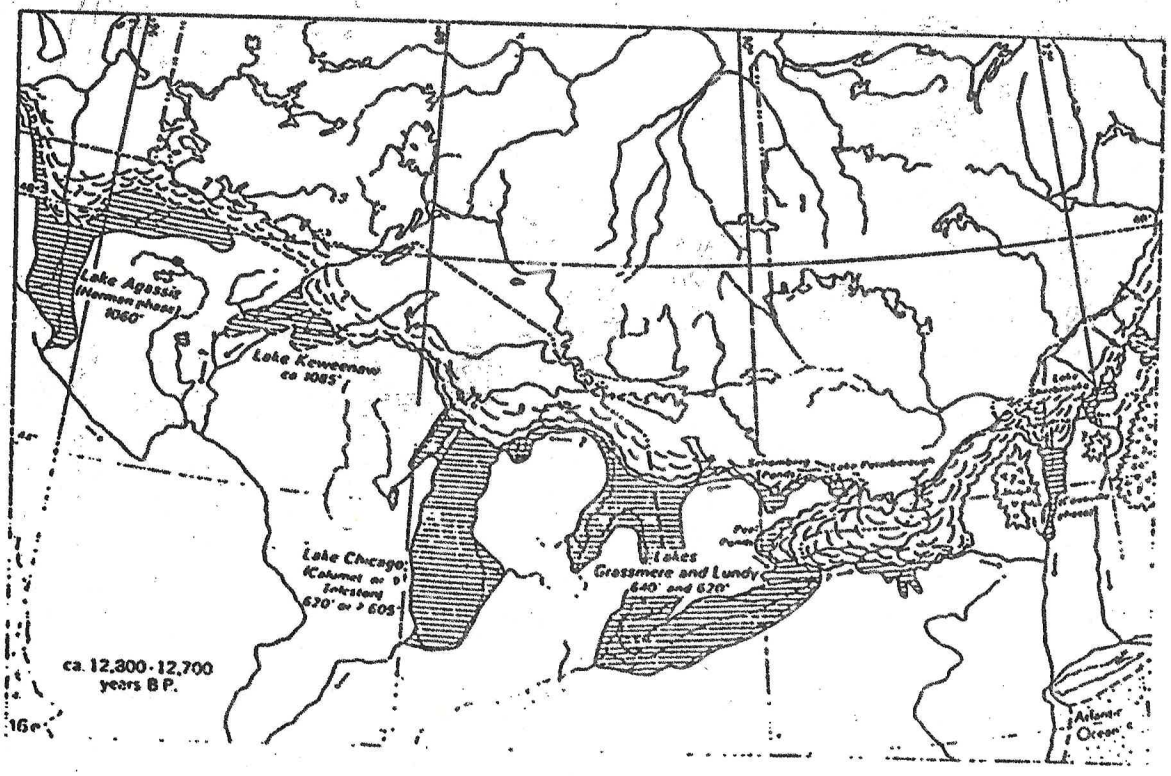
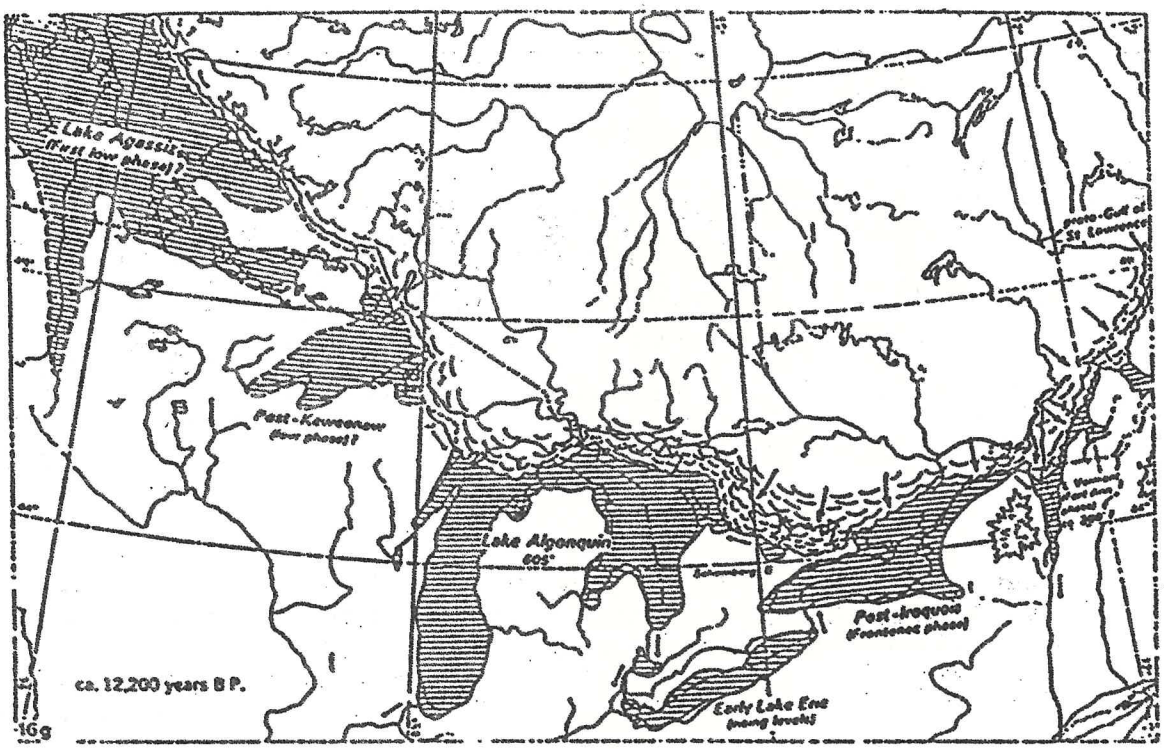
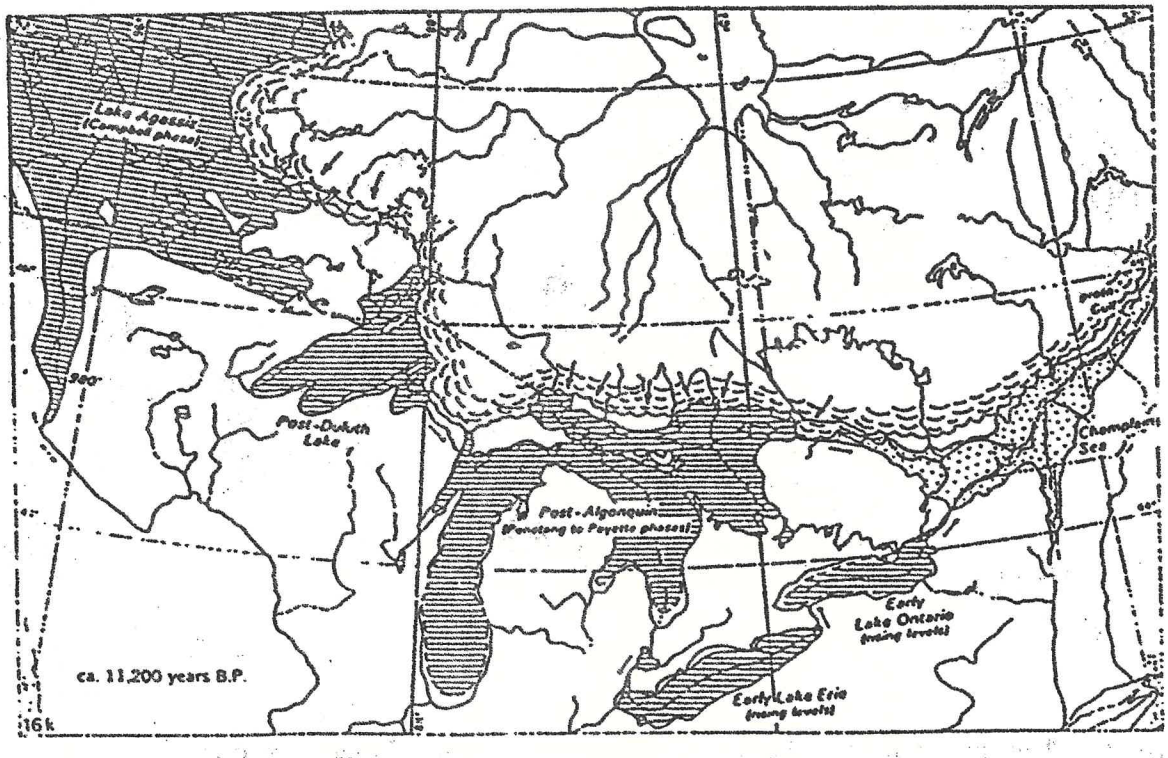


Figure 2. The retreat of the Laurentide Ice Sheet (Late Wisconsin Glaciation) from Eastern Ontario (after Prest, 1970).
2a: Lake Iroquois drainage through the Mohawk-Hudson river system.



2b: Frontenac-phase outlet through Lake Vermont (present day Lake George).



2c: Removal of the ice block from the St.Lawrence Valley, and encroachment of the Champlain Sea.

INSECT DIVERSITY IN THE KINGSTON AREA

by Adrian Forsyth

Insect diversity is correlated with and dependent on plant diversity. The physiographic and geological variety of the area produces a combination of the boreal forests with mixed deciduous forest with many Carolinian species, limestone alvar communities with relict western species, acid Sphagnum bogs, calcareous fens, marshes, sand dune areas. This variety coupled with the creation of successional plant communities through agriculture and forestry has given the Kingston area a tremendously rich flora. This, in turn, allows a tremendously diverse insect fauna, one of the richest in Canada.

A checklist of the large moths (Macroheterocera) of the area by Ward et al. (1974) indicates a fauna of some 820 species, a richness higher than that of most other North American and European localities. There are nearly 100 species of butterflies in the area (Layberry, et al. 1982). These insects are especially well known in the Kingston area because extensive research has been conducted on them. The Queen's University Biological Station has been the site of many years of blacklight sampling, rearing programs and ecological studies (see Harmsen et al. 1973, Ward et al. 1974, Karban and Ricklefs 1983, for references). The Microlepidoptera, the families of small moths, are probably equally diverse but have not been well studied.

The numbers of species of moths and butterflies depend directly on plant diversity since they are virtually all plant feeders. Research by the Canadian Forest Insect Survey, Karban and Ricklefs (1983), and Futuyma and Gould (1979) indicate that the species richness of moths and butterflies is not primarily the result of rigid host specialization with each plant species supporting its own special set of herbivores. Manya amoths have generalized diets while rigid specialists are comparatively less common. However, in terms of abundance, that is the number of individuals found in an area, specialist species tend to be common. This is also true of extreme generalists while species with an intermediate diversity in diet tend to be less numerically common than either specialists or generalists.

No major studies have been done on other groups of herbivorous insects in the area, for example, sawflies, beetles, true bugs and sap-sucking Homoptera but it is expected that they show comparable richness and diversity. Although this diversity is associated with the wealth of plant species it may be that it is other insect species, predatory and parasitic types, which are primarily responsible for promoting high herbivore diversity. There is little evidence indicating that interspecific competition for food is important in determining the local species richness of herbivorous insects, especially in natural undisturbed habitats.

Episodic outbreaks do occur leading to some defoliation and competition for food. But most insect ecologists now believe that predation and especially parasitism, by other insects regulates herbivorous insect communities.

A moth species, for example, typically supports its own rich guild of parasites, principally families of parasitoid wasps (Hymenoptera) and some flies. These include egg parasites, specialists on the caterpillar stage, another set of several pupal parasites and, less commonly, parasites of the adults. These parasites then support hyper-parasite species, parasites of parasites. There are even hyper-hyper-parasites. The result is that each plant species typically supports several to dozens of herbivores which support several to dozens of parasitoids. Thus, a single species of oak may provide a resource base for thousands of insect species.

The tendency of generalised parasitoids to locate their host victims through searching specific host plants and microhabitats favors the adaptive radiation of sympatric species (occurring together) to evolve difference host preferences even though there is no direct and overt conventional competition between the herbivores. The adaptive radiation into "enemy-free" space is an ongoing process that continues as the vegetation zones of the area shift in response to post-glacial climatic changes (see Crowder, Blue Bill Vol. 33:37-39). Accordingly, in this Kingston area, host plant races exist for many Lepidopteran species, races that are ecologically distinct from members of the same species found in other localities. The degree of this local differentiation remains largely unmapped. The plants themselves contribute somewhat to this process of local differentiation and diversification by altering their chemistry according to the local herbivore population but again little is known of the process. Suffice it to say that diversity begets diversity through the constant interplay between the plant, the herbivores and the parasitoids and predators.

The study of this concatenation of species richness is now one of the busiest areas of ecological research. However, it is safe to say that much of the fundamental research is totally lacking. Although the Kingston area boasts a good sample of moths and butterflies, nothing exists for the vastly richer parasitoid groups. It is clear that the area supports many localised and rare species. These species are vulnerable to localised extinction through habitat disturbance and, most recently, through the spread of the Gypsy Moth. Massive spraying of Baccilus spores to combat Gypsy Moths will cause mass mortality of thousands of other species of moths and butterflies. That the Gypsy Moth will be little affected is already well known from its history in New England. We may expect the common and widespread herbivore species to survive but rare and local species may well go locally extinct.

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MAMMALS OF SOUTHEASTERN ONTARIO

by Frank Phelan

The following checklist has been compiled to indicate not only the presence/absence of mammal species in our area, but also to depict their relative abundance. Additional notations give relevant traits and habitat. The nomenclature and taxonomic groupings follow that of Banfield (1974), which contains minor differences from the earliest published field guide of Burt and Grossenheider (1964).

ORDER *MARSUPIALIA*

Super family - *Didelphoides*

Opossum - *Didelphis virginiana* - only Marsupial in region, very rare, extreme northern limit of range, woodland, old orchards. FJSP has 2 sight records in past 15 years, one in what is now Frontenac Park.

ORDER *INSECTIVORA*

Family - *Soricidae* (Shrews)

Masked Shrew - *Sorex Cinereus* - one of our smallest shrews, 80-110 mm. 3.5-5.5 g, locally common, wide variety of habitats.

American Water Shrew - *Sorex palustris* - one of our largest shrews, 140-160 mm, 6-11 g, rare, streamsides and low bogs.

Smoky Shrew - *Sorex fumeus* - one of the largest Sorex, 110-125 mm, 6-11 g, uncommon, birch and hemlock forests.

Pigmy Shrew - *Microsorex hoyi* - one of the smallest mammals, 75-105 mm 2.3-4 g, rare, woodland interspersed with grassy areas.

Short-tailed Shrew - *Blarina brevicauda* - short tail, about 25 mm, 12-23 g, common, slaty coloring, moist woodland.

Family - *Talpidae* (Moles)

Hairy-tailed Mole - *Parascalops breweri* - short hairy tail about 3 cm, 150-170 mm, 40-65 g, uncommon, sandy loam soils.

Star-nosed Mole - *Condylura cristata* - 22 fleshy fingerlike feelers at of nose, 170-205 mm, 35-75 g, uncommon, swamps, bogs, low wet meadows.

ORDER *CHIROPTERA* (BATS)

Family - *Vespertilionidae*

Little Brown Bat - *Myotis lucifugus* - our most common bat, 80-95 mm, 6-10 g, colonial, often uses buildings as nurseries.

Keen's Motis - *Myotis keenii* - 79-90 mm, 6-9 g, ears when folded forward extend beyond tip of nose, rare.

Small-footed Bat - *Myotis leibii* - 73-82 mm, 5-8 g, foot less than 8 mm, rare.

Long-eared Bat - *Myotis septentrionalis* - 75-90 mm, 3-6 g, roost in trees in small groups, uncommon, dry forests.

Silver-haired Bat - *Lasionycteris noctivigans* - 90-115 mm, 6-11 g, hairs tipped with white, solitary, rare.

Eastern Pipistrelle - *Pipistrellus subflavus* - 81-89 mm, 3.5-6 g, tricolored fur, locally common.

Big Brown Bat - *Eptesicus fuscus* - 96-117 mm, 11-17 g, tragus blunt, common, often uses buildings as nurseries.

Red Bat - *Lasiurus borealis* - 93-115 mm, 6.5-13.5 g, reddish fur, solitary, uncommon, roosts in trees.

Hoary Bat - *Lasiurus cinereus* - 130-149 mm, 26-31 g, largest of our bats, hairs tipped in white, solitary, rare, woodland.

ORDER *LAGOMORPHA*

Family - *Leporidae*

Eastern Cottontail - *Sylvilagus floridanus* - 400-485 mm, 900-1800 g, our commonest rabbit, patch of hair at nape of neck bright rufous, 2 pairs of upper incisors, common, mixed woodland with open areas.

Snowshoe Hare - *Lepus americanus* - 380-506 mm, 1-2 kg, brown summer coat, white winter coat, most body hairs dark at base, large feet, locally common, wooded areas near watercourses, swamps.

European Hare - *Lepus europaeus* - 714-762 mm, 3.5-5.5 kg, underparts pure white, tail dark above and white below, locally common, open habitat, largely confined to areas bordering lower Great Lakes.

ORDER *RODENTIA*

Family - *Sciuridae* (Woodchuck, squirrels....)

Eastern Chipmunk - *Tamias striatus* - 225-266 mm, 66-113 g, 3 dark and 2 light stripes on side of face, 5 dark and 4 light stripes on back and sides, tail grayish above and fulvous beneath, very common, woodlands.

Woodchuck - *Marmota monax* - 530-645 mm, 2-4.5 kg, 4 clawed toes on front foot, 5 clawed toes on hind foot, guard hairs banded black-buff-black-buff-black, common mixed habitat with open areas.

Gray or Black Squirrel - *Sciurus carolinensis* - 405-510 mm, 340-680 g, two colour phases - black and gray, blond squirrels may be locally common, common, hardwood forests.

American Red Squirrel - *Tamiasciurus hudsonicus* - 283-345 mm, 120-250 g, reddish-gray pelage, black line along sides between belly and upper parts, loud ratchet-like call, locally common, coniferous forests.

Northern Flying Squirrel - *Glaudomys sabrinus* - 245-295 mm, 74-125 g, belly hairs bicoloured white with black at bases, uncommon, woodland.

Family - *Muridae (cricetidae)*

Deer Mouse - *Peromyscus maniculatus* - 119-205 mm, 10-31 g, 2 races *bairdi* and *gracilis*, prairie and woodland respectively, bicoloured tail - gray above with white below - uncommon, woodland with open areas.

White-footed mouse - *Peromyscus leucopus* - 141-195 mm, 12-31 g, white feet and belly, ear 15-18 mm, from notch, indistinctly bicoloured tail, common, forested areas near open country.

Gapper's or Boreal Redback Vole - *Cleithrionomys gapperi* - 116-158 mm, 16-17 g, broad chestnut stripe down middle of back, tail bicoloured - black above and gray below - belly hairs bicoloured -black at base and white at tip - locally common, hardwood forests and conifer swamps.

Southern Bog Lemming - *Synaptomys cooperi* - 99-132 mm, 14-39 g, short tail thick fur, 4 toes on front foot, locally common, low bogs or wet meadows.

Muskrat - *Ondatra zibethicus* - 477-636 mm, 810-958 g, webbed toes, tail laterally flattened, common, aquatic habitats.

Meadow vole - *Microtus pennsylvanicus* - 120-188 mm, 20-68 g, long tail more than 37 mm, ears nearly concealed, common, wide range of habitat.

Norway Rat - *Rattus norvegicus* - 316-426 mm, 195-287 g, locally abundant in dumps and human habitations.

House Mouse - *Mus musculus* - 150-180 mm, 12-23 g, 10 mammae, tail scantily haired, yellow tinge on under parts, locally common, fields and human habitations.

Family - *Dipodidae (Zapodidae)*

Meadow Jumping Mouse - *Zapus hudsonicus* - 182-225 mm, 15-23 g, large hind feet, long tail, white tip on tail, colorful pelage, rare,forests especially along watercourses.

Woodland Jumping Mouse - *Napaeozapus insignis* - 205-250 mm, 19-27 g, large hind feet, long tail, white tip on tail, colorful pelage, rare, forests especially watercourses.

Family - *Erethizontidae*

Porcupine - *Erethizon dorsatum* - 630-680 mm, 4-9 kg, sharp quills over body, common, forested areas.

ORDER *CARNIVORA*

Family - *Canidae*

Coyote - *Canis latrans* - 1155-1320 mm, 10-23 kg, yellowish-gray fur, legs, feet, ears and muzzle yellowish, throat and belly white, nose pads less than 25 mm wide, when running Coyotes carry tail low, locally common, open country and mixed habitat.

Wolf - *Canis lupus* - 1570-1650 mm, 31-46 kg, coloration like Coyote, nose pad more than 30 mm wide, when running wolves carry tail high, rare woodland and woodland bordering open country.

Red Fox - *Vulpes vulpes* - 955-985 mm, 4.5-7 kg, colour variations, usually reddish-yellow, some black in tail, tail tipped with white, common, woodland interspersed with open areas.

Grey Fox - *Urocyon cinereoargenteus* - 760-1060 mm, 3.4-5.9 kg, salt and pepper pelage, specimens from Brockville area early 50's, possible accidental occurrence, present status unknown.

Family - *Procyonidae*

Raccoon - *Procyon lotor* - 655-960 mm, 5-16 kg, black mask, ringed tail, common, wide variety of habitats.

Family - *Mustelidae*

Ermine or Stoat (Short-tailed Weasel) - *Mustela erminea* - 242-315 mm, 45-105 g, black tip on tail, tail less than 1/3 total length, dark brown with white undersides in summer, white in winter, uncommon, woodland.

Long-tailed Weasel - *Mustela frenata* - 284-405 mm, 85-267 g, black tip on tail, tail more than 1/3 total length, dark brown with white undersides in summer but white does not extend to feet or toes, white in winter, uncommon, wide variety of habitats.

Least Weasel - *Mustela nivalis* - 172-205 mm, 40-50 g, short tail about 5 cm, no black tip on tail, rare, open habitats.

Mink - *Mustela vison* - 420-620 mm, 665-964 g, dark brown, white chin and sometimes white spots on belly, common, woodland near water.

Striped Skunk - *Mephitis mephitis* - 509-665 mm, 2-5 kg, conspicuously black and white, common, wide variety of habitat.

River Otter - *Lutra canadensis* - 1 m or larger, 4.5-10 kg, webbed feet, 5 cheek teeth, uncommon, watercourses.

Family - *Felidae*

Bobcat - *Lynx rufus* - 755-890 mm, 6.5-14 kg, ear tufts, spotted coat even on legs, black on tip of tail, once common now possibly accidental, swamps and broken country.

Lynx - *Lynx canadensis* - 760-1060 mm, 5-17 kg, long tufts on ears, tip of tail completely black, rare and accidental, forested areas and swamps.

Family - *Ursidae*

Black Bear - *Ursus americanus* - 1.2-1.8 m, 90-270 kg, rare forested areas.

ORDER *ARTIODACTYLA*

Family - *Cervidae*

Whitetail Deer - *Odocoileus virginianus* - 1.8-2.3 m, 68-136 kg, conspicuous white tail, locally common, woodland bordering open area.

Moose - *Alcea alces* - 2-2.8 m, 330-820 kg, rare and accidental, coniferous forests especially along watercourses.

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AMPHIBIANS AND REPTILES OF EASTERN ONTARIO

by Francis R. Cook

AMPHIBIANS

Amphibians may be the most abundant terrestrial vertebrate animals in eastern Ontario in terms of numbers of individuals. Of all the vertebrates, amphibians are the only group which has no protective scales, feathers or fur. Their skins are, however, highly glandular; their profuse secretions serve for protection from both predators and desiccation. They are poorly adapted for climates which combine both cold and aridity, and do not occur north of the tree line. Changes in temperature and rainfall levels and patterns and the availability of aquatic or moist habitats greatly affect their reproductive success and relative abundance.

As the evolutionary link between fish and reptiles, amphibians are an archaic line, but one contemporary group, the frogs, has 2,770 living species and a world-wide distribution that excludes only Greenland, Antarctica, and some oceanic islands. The other orders still represented have fewer species (salamanders 336; caecilians 154) and more restricted distribution: the salamanders mainly to north temperate regions (except for the family *Plethodontidae* which has invaded the New World tropics); and the caecilians in the tropics in both eastern and western hemispheres (Goin et al. 1978; Duellman 1979). Of the 3,260 amphibian species in the world (Duellman 1979), Canada has only 40: 21 frogs and 19 salamanders (Cook 1984). The seventeen species (42.5% of those recorded for Canada) that occur in eastern Ontario (Cook 1981) are part of the Eastern Forest Herpetofauna as defined by Savage (1961). After each successive Pleistocene glaciation, amphibians have had to reinvade Canada: none are endemic here. Since the most recent glaciation, the Wisconsin, some species may have spread north from Mexico-Texas (Chorus Frog), Lower Mississippi Area (Mudpuppy), or Southern Appalachian (Two-lined Salamander) refugia, but others are now too widespread for their origin to be traced (Bleakney 1958a). All but two of the eastern Ontario species range east to the Maritime Provinces: 10 are recorded west to eastern Manitoba, four reach the Rocky Mountains and one even extends to Alaska and the mouth of the Mackenzie River in the Northwest Territories. The latter, the Wood Frog, is the only amphibian in North America to range north of the Arctic Circle (Cook 1984).

FROGS

The frogs belong to three families, all of which breed in aquatic situations, lay eggs protected only by a jelly covering, and hatch into tadpoles. These are effectively adapted to utilize the spring outburst of aquatic vegetation, particularly in temporary meltwater ponds from which they escape by transformation into frogs before the pond dries in summer. In this environment they avoid competition or predation by fish. However, some species (the Bullfrog, the Mink Frog and generally the Green Frog) breed successively only in permanent water. Their tadpoles must overwinter at least one, generally two and perhaps three years in the Bullfrog. Tadpole identification to family for local species can be based on colour, as only toad tadpoles are black both above and

below; and on the spacing of the eyes, as the widely-spaced eyes in treefrog tadpoles project from the outline of the body when they are viewed dorsally and those of true frog (*Ranidae*) tadpoles do not. A standardized staging system for eggs and tadpoles is given by Gosner (1980) and identification keys by Altig (1970). All of the northern frogs lay large numbers of eggs; the variation reflects size differences both within and between species. For example, a 26 mm Spring Peeper contained 456 eggs, a 34 mm one contained 1,117; a 111 mm Bullfrog had 13,749 eggs, a 138 mm one had 22,713 (data from a Gatineau Park, Quebec, study, McMurray 1984). The developmental time for eggs varies with temperature, and the range of temperatures in which normal development is possible varies between species; the eggs of more northern species develop faster at cold temperatures than do those of southern species (Moore 1939). In addition, some species lay single eggs (Spring Peepers), others lay eggs in strings (toads), and many deposit masses of various sizes. Earlier breeders (Wood Frogs) lay globular masses below the surface where they will not be killed by the surface freezing during a cold night, later breeders (Bullfrogs) lay a mat of eggs on the surface and avoid oxygen deprivation risk for interior eggs of a mass in the warmer oxygen-poorer water. Males of each eastern Canadian frog species have distinctive calls which are given throughout the breeding season when temperatures are suitable. Often calling is most active at dark. Some frogs give distinct advertisement (female-attracting) and aggressive (male interaction) calls. Breeding times vary with species and with latitude, altitude, the depth of water and the amount of exposure of the site. The dates below are for 1973-1985 at Bishops Mills, Grenville County (44o52'N) from my unpublished a\data. South and north of this area calling will begin earlier and later respectively. Some early-breeding frogs will also be heard on warm days in the fall; although late calling does not result in breeding at this latitude, it presumably reflects attainment of breeding condition for the following spring.

BUFONIDAE. The single species, the American Toad *Bufo americanus* is short-legged and terrestrial. It transforms at about 10 mm snout-vent length, reaches sexual maturity at 50 mm, and attains a maximum of 114 mm. [Adult sizes throughout are from Conant (1973); transformation sizes from Wright (1914)]. Toads are generally some shade of brown with greenish, yellowish, or reddish hues, but their distinguishing characteristic is that they are covered with prominent warts. A pair of parotoid glands behind the eyes are diagnostic, as are the bony cranial crests between the eyes. Their call is a long trill sometimes lasting a half a minute. The lowest body temperature for a calling toad is about 10 C (Cook 1983). Calling: first 13 April 1981, 27 April 1984; last in May 1985, 24 June north to Hudson Bay to the Deer River, Quebec, at 56o17'N (Cook 1964a), and possibly to Winisk, Ontario (Schueler 1973).

HYLIDAE, the treefrogs, are represented by three species. All are short-legged and all have at least minute discs at the end of each toe. The Chorus Frog *Pseudacris triseriata* is a small ground-living species which does not climb above tall grasses and is abundant in fields and clearings. It transforms at about 10 mm and is adult by the next spring at 20 mm, and may attain a pattern of darker longitudinal lines or of spots or a combination of both. The toe discs are minute. Their call can be imitated by running a thumbnail over the teeth of a comb. Earliest 15 March 1973, 27 April 1983; latest 9 May 1977, 2

June 1973. The subspecies in eastern Ontario, *Pseudacris t. triseriata*, occurs north to 7 miles southeast of Pembroke (Cook 1964b) and the Parry Sound region (Weller and Palermo 1976) and ranges east only to the Eastern Townships of Quebec (Bleakney 1959b). In the north, a western invader, the Boreal Chorus Frog, *P.t. maculata*, disjunct from contact with it, ranges north and east to the Moosonee area (Cook 1964b; Schueler 1973).

The Spring Peeper *Hyla crucifer* also transforms at about 10 mm and is mature at 20 mm. It reaches a maximum of 36 mm and is brown, characteristically with a cross-shaped dark mark on the back. It climbs to moderate heights in bushes and inhabits parkland and forested areas. Its very distinctive call is a shrill and rapidly repeated "peep". Earliest calling 30 March 1977, 1979, 22 April 1975; latest 30 May 1979, 17 June 1985. It ranges north in Ontario to Attawapiskat on James Bay (Schueler 1973) and in Quebec to River Again (51o50'N)(McCoy and Durden 1965).

The Gray Treefrog *Hyla versicolor* transforms at about 6 mm, is mature at 37 mm and attains a maximum of 60 mm. It changes colour according to a number of factors including temperature and humidity and often matches its background to the extent of being virtually invisible. It is always green on transformation but may be green, gray or brown as an adult, with an irregular, often star-shaped blotch on the back. There is bright yellow or orange on the inner part of the hind legs. This is vividly exposed when the frog moves, but concealed when it is at rest, thus probably serving to confuse a potential predator. It will forage high into mature trees. Its call is high and pulsed, and has been likened to the call of the Red-headed Woodpecker. Earliest calling 18 April 1976, 20 May 1984; latest 28 June 1975, 19 July 1982. Occasional individuals will often give calls from the trees before and after the breeding season, particularly on hot spring days and on humid close summer days before a thunderstorm. It ranges north to the Sudbury District in central Ontario and east to the Eastern Townships of Quebec, with a disjunct population in New Brunswick (Bleakney 1958). Populations in western Ontario (Logier and Toner 1961) have apparently spread north from south of Lake Superior).

RANIDAE, the typical frogs, have six species, four of which are widespread throughout the area. All except the Bullfrog have dorsolateral folds - raised ridges one on each side of the back. The Bullfrog has a ridge around each eardrum. All lay eggs in masses, either under or on the surface of the water and all have tadpoles with their eyes close together. The Woodfrog *Rana sylvatica* transforms at about 16 mm, is mature at 38 mm and reaches a maximum of 65 mm. It is brown with a dark "mask" through the eye expanding behind to cover the eardrum. About 2% of individuals in eastern Ontario have a light line down the centre of the back (Schueler and Cook 1980). They live in or adjacent to low woodland. The call is a sharp "quack", sometimes rapidly repeated. Earliest calling 25 March 1979, 16 April 1978, 1982; latest 18 April 1977, 6 May 1975. This is the most northerly ranging frog in North America, reaching the tree line (Cook 1984).

The Leopard Frog *Rana pipiens* transforms at about 24 mm, is mature at 58 mm and attains a maximum of 111 mm. It is usually green but sometimes is brown and has bold round or oblong spots that have a light edge.

It is a frog of open areas, primarily breeding in marshes and foraging in fields, but may turn up almost anywhere. The correlations between its pattern and habitat have been extensively analyzed by Schueler (1982). Its call is a low pulsed snore, often ending with a few rapid chuckles. Earliest calling 13 April 1979, 28 April 1975; latest 2 May 1985, 23 May 1981. They range north to Cape Henrietta Maria on western Hudson Bay (Schueler 1973) and to Labrador (Bleakney 1958a).

The Green Frog *Rana clamitans* transforms at about 30 mm, is mature at 57 mm, and attains a maximum of 102 mm. It is variable in colour, green or brown or both, often with irregular dark spots. It is aquatic and inhabits ponds, streams and rivers. Its call is a banjo-like "chung". Earliest calling is 26 May 1981; latest 15 August 1981, 1982. It ranges north to Timiskaming District in Quebec to Noranda (Longier and Toner 1961).

The Bullfrog *Rana catesbeiana* transforms at 43 mm or more, is not mature until 95 mm, and attains lengths of over 150 mm. It is green or brown in coloration with indefinite dark spots. It lacks dorsolateral folds. Large individuals can be identified by size alone, newly transformed juveniles are peppered with black dots. It is a frog of permanent water, ponds, lakes and rivers. Its call is a deep "jug-o-rum", or "oua-oua-ron" which sounds like a bull in full roar from a distance. Earliest 9 June 1982, latest 5 August 1981. Bullfrogs occur north in Ontario to Lake Timagami in the Nipissing District (Logier and Toner 1961).

Two other *ranid* frogs are more restricted in distribution. The Pickerel Frog *Rana palustris* transforms at 23 mm, is mature at 44 mm and attains a maximum of 87 mm. It resembles a Leopard Frog but is brown (never green) with square or rectangular spots and with bright orange or yellow on the undersurfaces of hind legs and lower belly (Green, Bull and Mink Frog males have yellow throats, which may extend on to the other underparts). Pickerel Frogs are largely woodland and swamp frogs and their former range may have been reduced by the agricultural clearing of eastern Ontario. Their call is a snore like that of the Leopard Frog, but more rapid and higher in pitch. We have no calling dates but elsewhere they breed over the same time span as toads (Wright 1914). They range in Ontario to Algonquin Park (Oldham and Sutherland 1986).

The Mink Frog *Rana septentrionalis* transforms at about 30 mm, is mature at 48 mm, and reaches a maximum of 76 mm. It resembles a Green Frog, but has less prominent dorsolateral folds and has often a reticulated pattern. The spotting on the hind legs is diagnostic - Green Frogs have bars which are at right angles to the long axis of the leg; Mink Frogs have oval spots which are elongated along the long axis of the leg. Freshly handled Mink Frogs have a distinct odour, like that of a mink or of rotten onions. Mink Frogs require permanent bodies of water, and are often inhabitants of creeks or bays of lakes, particularly where there is an inlet or outlet, and often where there is a cover or lily pads. They are the most wary and aquatic of our species, and are generally absent from low agricultural regions. Their call is a "tunk" which may be repeated rapidly. Earliest calling 9 June 1982; latest 12 August 1981. In eastern Canada they range almost as far north as Wood Frogs, being recorded to Lac Agineau , 57o13'N (Schueler 1973), Lake Nathalie, 53o29'N (McCulloch and Bider 1975) and Kanaaupscow Post, 54o05'N (Oxley et al. 1977).

SALAMANDERS

Salamanders offer many contrasts to frogs in life history and habitat. They have no call but perform an elaborate courtship "dance" to enable females to recognize conspecific males. Salamanders lay jelly-coated eggs but generally fewer than frogs do. These may be deposited singly or in small masses. Salamander larvae retain external gills until transformation and develop external front legs first and hind ones later. (In the Red-backed Salamander the eggs are laid on land and the larvae stage is passed in the egg.) Aquatic larvae are highly carnivorous and feed on a variety of invertebrates and even on tadpoles and smaller salamander larvae. Detailed descriptions of larval forms of species that occur in Ontario can be found in Bishop (1941). Four families of salamanders occur in eastern Ontario.

PROTEIDAE is represented by a single species, the Mudpuppy *Necturus maculosus*. This is the largest and most aquatic species, reaching a total length of 486 mm. It inhabits lakes, rivers and permanent creeks. The larvae are black with longitudinal broad yellow stripes but the adults are a dull muddy brown with irregular black spots. Adults retain external gills and never leave the water. They are sometimes caught by fishermen. The female deposits eggs on the underside of a submerged flat stone and guards the eggs until they hatch. Mudpuppys occur north to the Algoma District in central Ontario and have also spread into western Ontario (Logier and Toner 1961).

SALAMANDRIDAE has only one species, the Eastern Newt *Notophthalmus viridescens*. It attains a maximum size of 140 mm and is the most variable of our salamanders in life history strategies. It breeds in a variety of aquatic situations from temporary ponds to lakes. In lakes the adults remain aquatic year-round and are olive-green with particularly deep tail fins in the males. In more temporary situations the adults are smaller and are generally brown. The larvae transform into small red juveniles called "efts" which may spend from one to three years on land in woodland habitats before returning to the breeding site at maturity. Efts and adults characteristically have a row of black-bordered red spots along each side. The Adults have bright yellow undersides peppered with black dots. Newts occur north to Lake Nipigon (Logier and Toner 1961).

AMBYSTOMATIDAE, the mole salamanders, has two species. The larger (to 248 mm) is the Yellow-spotted Salamander *Ambystoma maculatum* which is black with large yellow spots and the smaller (130 mm) is the Blue-spotted Salamander *Ambystoma laterale*. Both are woodland salamanders which come to temporary ponds to breed in the spring at the time the first frogs call and the snow is barely melted from the ground. At this time they may be seen crawling over the pond bottoms at night in surprising numbers if one ventures out to search with a headlamp or flashlight. They also can be found migrating to ponds on rainy nights in the early spring. Dates of earliest appearance of Blue-spotted Salamanders for Bishops Mills, Grenville County, range from 24 March 1979 to 19 April 1972. The remainder of the year the only evidence of them is an occasional individual under a log or stone and the growing hoards of larvae in the ponds. Of the two, the Blue-spotted is most widespread and may survive better in second-growth and similarly man-altered areas. Individuals over 130 mm which resemble Blue-spotted Salamanders are present in some areas. These (and others

indistinguishable by size) are triploids (3 instead of the normal 2 sets of matching chromosomes) which are almost always female and breed with the normal Blue-spotted Salamanders. They are thought to be the result of hybridization with a more southern species, the Jeffersonian Salamander *Ambystoma jeffersonianum*. These triploids occur north to Algonquin Park (Brunton and Weller 1979) and are scattered in southern Ontario (Weller et al. 1979). They either have spread into the area with the Blue-spotted Salamanders or are relicts of a past invasion of Jefferson Salamanders (Bogart 1982; Lowcock 1986). Blue-spotted Salamanders are the most northerly distributed species and have been recorded in Labrador and central Quebec (Cook and Folinsbee 1976; McCulloch and Bider 1975). Yellow-spotted Salamanders have been collected in central Quebec to 49o54'N (Gordon and Cook 1980).

PLETHODONTIDAE are the lungless salamanders. They compensate for the lack of lungs by skin and mouth respiration. Three species are represented, showing a transition from terrestrial to aquatic existence. All are relatively small and share the family characteristic of a tiny nasolabial groove which runs from the nostril down to the upper lip. The Redback Salamander *Plethodon cinereus* reaches a total length of 102 mm. It may be uniformly lead-coloured above or have dark sides and a broad red stripe from the head to the tail. The underside is mottled with dark and light. It is completely terrestrial in forests, and can be found under stones or logs or inside rotted logs. The eggs laid in such damp situations are guarded by the female until they hatch. The distribution of this salamander is dependent on at least small patches of forest, and it has probably been eliminated from the most intensively cleared portions of the region. They have been reported from the north shore of Lake Superior in Ontario and the north shore of the lower St. Lawrence River to Quebec (Logier and Toner 1961).

The Four-toed Salamander *Hemidactylium scutatum* is so named because, in contrast to all our other species except the Mudpuppy, it has only four toes on the hind foot instead of five. Its maximum size is 102 mm and it is grayish or reddish brown above and milk white below with the underside dotted with black. It has a prominent constriction at the base of the tail which is a fracture point if grabbed by a potential predator. Four-toed Salamanders lay their eggs above woodland pools, typically in sphagnum moss, and the hatching larvae drop into the water and complete a brief larval period there. Their distribution is poorly known and seems to be in scattered areas that have woodland and sphagnum pools. Four-toed Salamanders have been reported north to the Montreal River, Timagami Provincial Forest (Bonisteel 1973) and of scattered occurrence in adjacent Quebec (Denman 1961, 1965; Gorham 1955; McCoy and Durden 1965; Gordon 1979).

The Two-lined Salamander *Eurycea bislineata* can reach a total length of 121 mm. It is light yellow-brown in colour, with a pair of dark lines the length of the back. The underside of adults is bright yellow or orange yellow. This salamander is a stream dweller which requires cool water. The eggs are laid in the water and the larvae develop to near mature size before resorbing their gills. The adults can be found under stones at the water's edge, and may wander some distance from the water in wet periods. Two-lined Salamanders are in most streams in the northern and eastern part of eastern Ontario but are absent from

the southern lowlands of the area. It has been reported north to the Onakana River in the Cochrane District of Ontario (50o37'N) by Kamstra (1983) and the Labrador by Cook and Preston (1979) and DeGraff, Boles and Lovisek (1981). They are common in southwestern Quebec (Gordon 1979; Weller 1977), and New Brunswick but absent from Nova Scotia (Cook and Bleakney 1960).

REPTILES

Reptiles are ectothermic except for those of large mass such as the Leatherback Turtle (Frair, Ackman, and Mrosovsky 1972). This dependence on external heat sources greatly inhibits their northward penetration into Canada. It is not surprising, therefore, that reptiles are represented in Canada by only 42 species, four of which are marine turtles which mainly migrate to our Atlantic or Pacific coasts during the summer months and do not nest here. On continental Canada and its adjacent islands there are 8 turtles, 5 lizards and 25 snakes (Cook 1984). Half of these (19) are present in eastern Ontario: all eight of the turtles, one lizard and ten snakes. This area is part of the Eastern Forest Herpetofauna as defined by Savage (1961). It is also on the boundary of two "herpetofaunal zones" delimited by Bleakney (1958) from the product of the mean July temperature times the length of the growing season as a good predictor of climatic effects on reptile distribution. Five species, the Stinkpot, Five-lined Skink, Ribbon Snake, Brown Snake, and Black Rat Snake, all reach their northern range limit within the area. Four others (the Spotted, Soft-shelled, and Wood turtles, and the Hognose Snake) are limited within the area to pockets or bands of favourable habitat. The reptiles present are a mixture of species from the postulated Lower Missipian (Map and Soft-shelled Turtles), and Atlantic Coastal Plain (Blanding's, Spotted, and Wood Turtles) glacial refugia, or both (Painted Turtles), or are widely distributed eastern forms (Bleakney 1958a, 1958b).

The turtles present belong to four families, three represented by only a single species. All species in the area are aquatic, but the Spotted and Wood turtles forage on land to a considerable extent during the summer. Females of all species come to land to nest from mid-May to early July. Some move considerable distances: Snapping Turtles at Algonquin Park may make a round trip between home range and nesting site of 16 km with a mean trip distance of 10.6 km (Obbard and Brooks 1980). Spring emergence is early. At Bishops Mills our first observation dates for Painted Turtles are 31 May 1977 to 29 April 1983, and just to the east of the area, at Montreal, Map Turtles have even been observed basking on ice floes in the "early spring" (Gordon and MacCulloch 1980). Hatching is dependent on the warmth of the summer months, but occurs from early September to early October, with emergence delayed in at least the late nests of Snapping and Painted Turtles until the following May if the fall is cool. Nest mortality, however, may be high. Overwintering is only successful where frost does not penetrate to the level of the nest and late nesting may be strongly selected against toward the northern edge of the range (Obbard and Brooks 1981). Larger species (Snapping and Soft-shelled Turtles) lay round eggs, the other lay oblong ones. Number of eggs varies from the extreme of 83 recorded for a Snapper (Bleakney 1957) to the 2-5 of the Stinkpot (Conant 1975). Hatching size is commonly about 25 mm (Snappers) to 29 mm (Blanding's and Map Turtles).

CHELYDRIDAE. The Snapping Turtle *Chelydra serpentina* is the largest of the turtles in the area. Adults attain a shell length of 48 cm. The largest local specimen, obtained from trappers near Almonte, weighted 22.5 kg. (Sizes throughout are from the species range as a whole as carefully documented by Conant (1975) unless specific mention is made of another source.) Snappers are dull brown in colour with some light streaks on the head. The upper shell (carapace) shows growth rings unless it is badly encrusted with algae. The undershell (plastron) is distinctive as it is greatly reduced to a bony cross. The tail is also unique, studded with places of bone reminiscent of some of the armoured dinosaurs. Snapping Turtles frequent a variety of aquatic habitats, utilizing both large permanent, and small temporary, bodies of water throughout the area. They are widely distributed in eastern Ontario and occur north to the Englehart River in the Timiskaming District of Ontario and to Val d'Or in Quebec (Schueler and Karstad 1975). They occur west of Saskatchewan and east to Nova Scotia (Cook 1984).

KINOSTERNIDAE, the musk and mud turtles, is represented by the Stinkpot, *Sternotherus odoratus*. Its distinctive narrow, high-domed shell does not exceed 137 mm in length. The carapace is brown streaked or flecked with black, and the head, limbs and tail are dark with two yellowish lines on each side of the head. It seems to prefer clear shallow water and may be locally common in the Rideau Lakes area and occurs in the Rideau and Mississippi Rivers (Cook 1981; Brunton 1981). In contrast to all other turtles in the area, it sometimes may not dig a nest but lay eggs along logs or on Muskrat houses.

EMYIDAE, the pond and marsh turtles, has five species in the area. The most abundant and conspicuous (because of its gregarious basking habits) is the Midland Painted Turtle, *Chrysemys picta marginata*. It has an olive or black carapace with a border of red markings above and below, and a yellow plastron usually marked with a dark patch of variable size in its centre. The head, limbs and tail are striped with red and yellow. These turtles reach a maximum size of 187 mm. Adult males are distinctive as they have extremely long foreclaws, the only species here to show sexual dimorphism in this character. It commonly inhabits shallow, heavily vegetated ponds, river backwaters, and bays of lakes throughout the area. Some aspects of its activity and morphological variation in nearby Peterborough County have been documented by Whillans and Crossman (1977). It occurs north in the Nipissing District to Lake Timagami (Logier and Toner 1961). A larger subspecies, *c.p. belli*, occurs in western Ontario.

The Map Turtle, *Graptemys geographica*, is larger, females attaining 273 mm and males 159 mm. These turtles have a flattened shell which may show a serrated ridge along its midline. They are green, heavily reticulated with yellow, a pattern which is suggested by the common name. The head and limbs are striped with yellow. Map Turtles prefer the deep water of lakes or rivers, and are usually only seen from a distance through binoculars, as they are difficult to approach closely, even from the water. They occur in the Rideau Lakes area, and in Lake Ontario and the Ottawa River (Cook 1981) and east in the St. Lawrence and Richelieu rivers (Logier and Toner 1961).

Blanding's Turtle, *Emydoidea blandingi*, has a shell length of up to 268 mm. It is black above, streaked with light markings. The upper head and the limbs are dark but the throat and chin are bright yellow and this is the best identifying mark. It inhabits quite heavily vegetated ponds, lakes and marshes. It is widely distributed but apparently localized. It reaches its distribution limit just beyond this area in Gatineau Park, north of Hull, Quebec (Cook 1981).

The Spotted Turtle, *Clemmys guttata*, is the smallest Canadian turtle, 127 mm. Its carapace is black with bright yellow or orange circular spots. The head, limbs and tail are dark, usually marked irregularly with yellow. In eastern Ontario it is recorded only from scattered bog ponds and lakes and only two localities are documented for the Eastern Townships of Quebec (Cook et al. 1980).

The Wood Turtle, *Clemmys insculpta*, is up to 229 mm. Its carapace is brown with prominent growth rings. The head and limbs are suffused with orange or reddish. Although widely distributed in eastern Canada from Lake Huron to the Maritime Provinces, it occurs only where there are sandy and gravelly rivers. In eastern Ontario it is recorded from a sandy belt from Fort Coulonge and Danford Lake in Quebec west through the northern portion of Algonquin Park (Cook 1984), and east to the Maritimes. There are a few records for southwestern Ontario some of which may be introductions or escapes as it is a popular pet turtle (Cook 1977). Evidence of a wider former range comes from Indian sites where it has been reported from Roebuck, Grenville County (Bleakney 1958c). It is our most terrestrial turtle and forages on land in summer for wild fruits and berries, but is also carnivorous.

TRIONYCHIDAE: The one species, the Spiny Softshell, *Trionyx spiniferus*, has a flat, pancake-shaped soft leathery carapace with flexible edges. It attains 432 mm. A greenish-grey to brown carapace has light centred dark spots in juveniles and males and blotches in females. In males it is covered with tiny spines. Softshells occur in rivers and lakes where there are sand or mud bars. In Ontario they occur in Lake Erie and rivers draining into it, and in the southwestern end of Lake Ontario. Apparently they are absent from the remainder of this lake but occur east of it in the St. Lawrence, Ottawa, and Richelieu Rivers (Logier and Toner 1961; Cook 1981).

LIZARDS

Although there are 3,307 species of lizards in the world, only one family, *Scincidae*, occurs in eastern Ontario. The skinks are a large world-wide family containing 1,029 species, nearly a third of the species of known lizards. Three of the five lizards recorded for Canada are skinks. The Five-lined Skink is the only lizard in eastern Canada. It reaches a maximum length of 205 mm. The young and females have five white-to-yellowish stripes on a black background dorsally and a bright blue tail. Males darken with maturity. It occurs in forested areas in southern Ontario reaching its northern limits at Georgian Bay in the west and Snow Road and Palmerston Lake in our area (Ussher and Cook 1979). ALthough it may be seen in the open foraging on hot days, it is more often found by turning suitable cover such as flat stones.

SNAKES

There are 2,267 species of snakes but only 25 occur in Canada. Among them are three species of rattlesnake, the only native Canadian reptiles that are hazardous to man. Two rattlesnakes have been recorded in Ontario but neither occurs in the eastern portion of the province. The Timer Rattlesnake, *Crotalus horridus*, is presumed extirpated from its former range in the southwestern portion of the province; the last verified occurrence was at Niagara Gorge in 1941. The more widespread Massassauga, *Sistrurus catenatus*, does not range east of the Muskoka Lakes near Georgian Bay (Cook 1984).

All snakes in eastern Ontario are members of the family *COLUBRIDAE*, a worldwide group containing over two-thirds (1,550) of the snake species. The most abundant and conspicuous group of *colubrids* in the area belong to the sub-family *Natricinae*. All its species represented here are live-bearing. Two species are black with longitudinal yellow stripes. The largest (to 124 cm) and most widespread is the Eastern Garter Snake, *Thamnophis sirtalis*. Outside eastern Ontario it is variable and this has been documented by Bleakney (1959a). It has been recorded further north than any other North America snake to southern James Bay (McCulloch and Bider 1975).

The other similarly patterned snake in the area is the Ribbon Snake, *Thamnophis sauritus*, which is slenderer than the Garter Snake, has a relatively longer tail, and has the lateral stripe on the third and fourth scale rows, rather than on the second or third. It is smaller in maximum length, 95.6 cm, and is more restricted in habitat, found mostly along creek, pond, and lake margins in contrast to the variety of terrestrial and aquatic habitats of the ubiquitous Garter Snake. It reaches the northeastern extent of its range in eastern Ontario, Morris Island on the Ottawa River (Tobias and Evans 1979) and St. Lawrence Islands National Park along the St. Lawrence (Woods and Cook 1976).

The largest *natricine* in our area is the Northern Water Snake, *Nerodia sipedon*, which can attain 135 cm. It has a pattern of dark brown rectangles separated by light interspaces down the back, and narrow brown bars separated by reddish ones on the sides, such that light and dark alternate between the back and sides. Anteriorly they may join for a short distance forming vertical bars. Large individuals may have the pattern faded and appear black. Water Snakes frequent lakes, rivers and ponds, and vigorously defend themselves if molested. They range north of Gatineau Park in Quebec (Cook 1981) and to Cedar Lake in the Algoma District in Ontario (Logier and Toner 1961). Garter and Water Snakes are primarily fish and amphibian predators, though Garter Snakes readily take worms, and large individuals will take small mammals occasionally.

Two small species also belong to this sub-family. The Brown Snake, *Storeria dekayi*, is a maximum of 52.7 cm, and pale brown above with paired dark spots which are often connected by bars across the back. Its underside is white or pink. The dorsal scales are in 17 rows.

The Redbelly Snake, *Storeria occipitomaculata*, is smaller, to 40.6 cm, and variable in dorsal colour: grey, black or brown. Its underside is red or orange and there are three yellowish-orange triangles on the neck. It has 15 dorsal

scale rows. Both species can be locally abundant but are not equally abundant at the same locality; both feed mainly on slugs and worms. The Redbelly Snake occurs north into the southern edge of the boreal forest, west to Saskatchewan and east to Cape Breton Island, but the Brown Snake is in southwestern Ontario and east only to just north of Montreal (Cook 1984).

The other five snake species belong to several *colubrid* groups (Dowling and Duellman 1978). All are egg layers, though some deposit them in an advanced state of development. The Smooth Green Snake, *Opheodrys vernalis*, reaches a maximum length of 66 cm. It is uniform green above and white or yellowish below, and occurs in fields or brush areas where it is rarely seen because of its matching coloration. It feeds largely on spiders and caterpillars (Judd 1960). It occurs north to Gogama in central Ontario (Logier and Toner 1961), west to central Saskatchewan and east to Cape Breton Island (Cook 1984).

The Ringneck Snake, *Diadophis punctatus*, attains a length of 62.5 cm and is slate grey above, with a yellow neck ring and yellow belly. The latter may have black dots. It feeds on salamanders, small frogs and snakes. It ranges north in Ontario north of Hawk Junction in the Algoma District (Logier and Toner 1961) and east to the Gaspe Peninsula of Quebec and to Nova Scotia (Cook 1984).

The Milk Snake, *Lampropeltis triangulum*, reaches 132 cm and has a series of black-bordered blotches along the back with two series of smaller, alternating blotches on the sides. There is a Y- or V-shaped mark on the top of the head. Young Milk Snakes have reddish blotches and a very pale ashy background colour. Milk Snakes feed primarily on small mammals which they subdue by constriction. They occur north to Gatineau Park, Quebec, west to Sault Ste. Marie in Ontario, and east to Yamaska along the St. Lawrence in Quebec (Logier and Toner 1961).

The Black Rat Snake, *Heterodon playrhinos*, attains a length of 116 cm and has a pattern of large dark dorsal blotches and smaller, alternating, lateral ones. It is grey, yellowish, or reddish, or entirely black. A slightly upturned snout is distinctive.

Hognose Snakes will spread their necks and strike (but always with the mouth closed) if threatened, and have been christened "bluff adders" in some parts of their range. If this fails, they will turn belly-up and feign death, with mouth gaping and tongue hanging out loosely. They are closely associated with sandy areas and feed primarily on toads, but also take frogs. In Ontario it occurs north to Georgian Bay and the southern borders of Algonquin Park, and east halfway along Lake Ontario (Logier and Toner 1961).

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THE SEASONS IN EASTERN ONTARIO

by Allen Keast
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Kingston lies in the northern deciduous forest zone (lat.44 13 N:long. 76 36 W) characterized by 5-month winters, short springs of a few weeks, warm summers of about 4 months when the forests are in full green leaf, and autumns that last about two months. This is on the basis of rationalizing that, phenologically, winter begins in November after the leaves have dropped, the air is cold and clammy, and outside temperatures drop to an average (10 years) of 3 degrees C. The first major snowfall usually occurs in early or mid-December, and ends with final snow melt in late March.

To the bird-watcher, spring may begin with the first tentative spring call of the Chickadee in mid-February (uttered on a sunny morning and notwithstanding the presence of metre-high snowbanks!), or it may begin with the return of the first male Red-winged Blackbirds to their ice-covered marsh in mid-March.

'Calendar-spring', in early March, may hold promise but little reality to the average citizen. After two or three protracted snow-melts followed by sudden blizzards, he is walking around like a bear with a sore head, convinced that spring will never arrive. But to the ornithologist the increasing daylengths, and the appearance of bare patches of ground, are starting to bring in the first Robin, Killdeer and Red-winged Blackbird. It is a time of anxiety to the ornithologically observant. Will a last heavy snowfall cover all the food and kill these first adventurous harbingers of spring?

By April there can be no doubt that spring is just around the corner. Strips of open water have appeared in Kingston Harbour and Cataraqui River and large flocks of ducks move in to live and feed on the newly available resources. The Snowy Owls and Snow Buntings that were such a feature of the ice-covered fields left with the disappearance of the snow cover and the Tree Sparrows, regular attendees at bird feeders, have also departed for the far north. House Finches are in full song and even the introduced English Sparrows greet sunny days with protracted and animated twittering. Woodcock arrive on the woodlots and begin their fascinating dusk calling and extravagant aerial displays. The Pussy Willows are sprouting and large rosettes of Skunk Cabbage melt their way through the snow. The marshes, still icy but now with patches of open water, swimming muskrats, and the occasional stately heron, are much less forbidding places. They will be enlivened with a dozen scattered male Redwings each vigorously defending a territory with flashing red epaulets and loud grating calls. April nights are shrill with the calls of the Spring Peepers and other frogs. Late April brings the flocks of northward migrating Canada Geese, long skeins of 20-250 individuals, honking nasally as they pass overhead. SOme years one can witness twenty flocks in the space of a few hours. In other years the migration extends over several days, some of the flocks move overhead at night, and the impact is not quite as great. At any time, however, the flocks of northward moving geese are a spectacular and exciting sight. No observer can witness them without a feeling of exhilaration.

Melting of the snow in the woods brings out the first wild flowers, Hepatica. Little clusters of white and pale mauve blossoms, each blossom 1-1/2 cm across, surrounded by a rosette of dark green leaves, and flecked with morning sunlight, is sure evidence that spring has arrived.

By May the signs of spring have become an avalanche. Robins are in full song. Phoebes have taken up nesting ledges in lakeside cottages and under bridges. Tree Swallows are in their hundreds, twisting and dancing over the water and fields as they feast on the massive emergences of chironomids. Half a dozen males all twittering melodiously at once is a feature of these flocks. In their more sober moments, the males investigate and defend every potential nesting hollow, whether it be a broken limb, nest-box, or old projecting piece of stove pipe. Chickadees, one of the few year-long residents, are at their noisiest in the first half of May. Hairy and Downy Woodpeckers are now audibly drilling and calling through the woods. Yellow-rumped Warblers, the first of the returning parulids, forage busily in the still leafless branches and on the forming buds of the trees. Along the roads European Starlings are engaged in a running battle with the farmers for ownership of mail-boxes, trying to fill them with nesting material faster than the local postman, or owner, can remove it. Every second fence post seems to have either a male Red-winged Blackbird or Meadowlark. Raptors are highly visible over the open fields and in the woods. Majestic Red-tailed Hawks and Turkey Vultures spiral high overhead, Kestrels hover in the fields, and the odd Northern Harrier beats to and fro over the ground seeking the careless Meadow Vole.

The pageant of the spring flowers is at its peak in early May, just before and as the trees are coming into leaf. Hepatica, Dutchman's Breeches, and Bloodroot last 7-10 days, and are followed by massive flowering of White Trillium. Trillium cover the depressions and undulations of the forest floor in masses of purest white. By now, the purple and yellow violets, red-and-gold columbines, blue phlox, and many less resplendent fry like Pussy-foot Mitrewart and Loosetrife, are very much in evidence. Marsh fringes and drainage channels are resplendent with masses of golden Marsh Marigold. The May flowering in the woods is matched in the gardens by crocuses, Scilla and Forsythia, followed by tulips, daffodils and snowdrops. The lawns are golden with (the much hated) English dandelion, and fields with yellow-flowering mustard (Brassica), another exotic introduction.

The breeding of birds begins in early May, with Bluebirds and Robins the forerunners. These species may have young as early as about May 19, coincident with the first leafing of the trees and ahead of the major production of insects. They succeed in raising their young, in the case of Bluebirds, on cutworms that have overwintered in the soil and on other early insects. Robins exploit the great quantities of earthworms available on the lawns in early spring.

The bulk of the returning migrants arrive in the first two weeks of May. Every day seems to bring in a new species. The air is filled with spring songs. There is a pre-dawn chorus that begins about half an hour before sunrise, and a wonderful post-dawn concert with a dozen or more species in full song simultaneously. And with occasional interruptions for feeding and activity, the

singers continue to perform daylong. Virtually every morning throughout the first half of May, there is a new species - the first House Wren, Northern Oriole, Rose-breasted Grosbeak, Warbling Vireo, Red-eyed Vireo, Least Flycatcher, Wood Pewee, or Scarlet Tanager. And, as a friend once remarked, "they seem virtually to topple from the sky singing". To the receptive observer, the first Oriole, Wren or Vireo call hits one like a sledge-hammer- one almost feels one should face the caller and reverently bow to the return of an old friend. The arrival of each returnee provides topic for conversation. With most species one bird seems to arrive a day or two ahead of its colleagues. Maybe it is an 'individual' thing, but these first comers vary in their assertiveness. I have known years when the first Oriole was relatively quiet, almost embarrassed to find that he is the only arrival; and other years when the first newcomer immediately vocally challenged the Robins, Chickadees or any other imagined rival he could find. Either way, within 3-4 days virtually all the males of a species seem to be back. That species is now vocally 'dominant' with all the individuals challenging each other with their territorial songs.

The main breeding season is from mid-May to late June. Most species, but not all, quieten down somewhat when they have eggs and young. Mid-May is lovely. The trees are in full leaf, rich vibrant green. The days are sunny, the skies bright. The waters of the lakes are still, and reflective of the vegetation crowding the shoreline. Birds are nest-building. The last of the spring wild flowers are at their peak. Birds are actively feeding, pursuing each other, and singing. Out on the lakes Loons are calling and Ospreys carry the last of their nesting material. Herons stalk in the shallows.

The warm days of June bring the first of the summer's wildflowers; the white oxe-eye daisies, purple cowvetch, bladderwort, bugloss, chickory, and purple irises. The eagerness of spring has given rise to a summer maturity. The trees are in full leaf and, in denser areas, the floor of the forest is in heavy shade. All the flowers that flourished there when the forest floor was lit by sunlight have long since gone. Insect traps set here produce nothing. As one walks along a dimly lit path there is no life except for the small shade-loving Wood Nymph butterflies. The large populations of insects are now located along the woodland edges and out in the fields. All the birds are up in the tree-tops. They are much quieter now; most are too busy feeding young to have time to sing. They are quite difficult to observe in the dense foliage.

In contrast to the broodiness of the deep woods, the edge areas, semi-open woodlots and the fields are now a hive of activity. BUtterflies and dragonflies are everywhere. The scene is enlivened with a great diversity of wild flowers of every colour. Chipping Sparrows, Indigo Buntings and American Goldfinches, all ground and edge-feeders, are highly visible. There are many young Robins about. Crows and BLue Jays have young out of the nest and they are noisy and highly visible. Mid-summer insects such as cicadas and crickets are noisy. Evenings are enlivened with the flashing of fireflies.

By July the pace of the season has noticeably slowed. The days are becoming hot and sultry, with mean temperatures of 68-70 degrees F. (19-21 C.) and maximum day temperatures of 82-89 degrees F. (20-32 C.). Bird breeding is just about over. Dominant sounds are those of young birds being fed, or the harsh

scoldings of anxious parents protesting the intrusion of scavenging Blue Jays. The little Chipmunks of the forest floor, always conspicuous, are now more noticeable as their shrill squeakings are not drowned out by calling birds. Little banded green garter snakes and 2 metre long black rat snakes are highly in evidence. Marshes may be showing evidence of stagnation. Little blue damsel flies and large dragonflies are everywhere. Bullfrogs, that have long ceased to call, plop into the water at one's approach. Water snakes that were sunbathing on an area of flattened reeds slither away. Kingbirds hawk the air for dragonflies and Herons flap leisurely by. Out in mid-lake, the Loons are tending young nearly as big as themselves. The young Ospreys are sitting on the edge of their nest, anxiously awaiting their next fish meal and anticipating their first flight.

The first migrants leave in July. Many species like the Northern Orioles and Yellow Warblers, and the ever-abundant Tree Swallows, vacated nesting sites as soon as the young were fledged. They spend the ensuing weeks escorting them through areas that, presumably, were poor for breeding but good for feeding. But netting studies show that some species like the little Least Flycatchers and the Yellow Warblers already start on their southward journey of July.

August is, in large degree, a duplication of July. The woods are heavy and brooding, the leaves of the trees are more leathery and produce few caterpillars. The fields are covered with flowers, now the first of the autumn crop of wildflowers. To the ox-eye daisies and cowvetch has been added great masses of yellow goldenrod. This grows up to a metre high and covers fields that in spring were grassed. There are several species of goldenrods, growing in different habitats; one in fields, one on rocky areas, another along the edges of the marshes. The marshes and lakes now sport magnificent masses of White Waterlily (Nymphaea), smaller yellowlily and others. The surface waters are sluggish and cluttered with heavy macrophytes that now reach the surface. The reedbeds, so filled with noisy Redwings a month or two earlier, are now silent. Much of the southward bird migration occurs in August so that by the end of the month a high proportion of the familiar summer friends are gone. But several old faithfuls are still prominent. Whereas the Tree Swallows left in early July, the Barn Swallows still inhabit the boathouse on the lake, perching there at night and using it as a starting place for long sweeping hunting surveys out over the water. Butterflies and dragonflies are still abundant. The former are now enjoying their second generation for the year. Grasshoppers are, however, now the main feature of the fields. As one pushes one's way through the goldenrod they rise in little swarms, a swift rising fluttering flight, then a precipitous drop to the ground.

September is a lazy month but falling temperatures restore one's vigour somewhat. Autumn wild flowers like the magnificent purple asters (Aster novae-angliae) introduce a dimension and colour not experienced all year. The leaves start to turn. In exposed rocky areas, and marshes where falling water temperatures are taking effect, patches of yellow and red foliage find an early expression. By mid-September the last of the harvesting hay is piled high in the fields. As the month wears on, all deciduous trees assume fall colours. The woods, the hills, the slopes, are a riot of orange, yellow and red, as oaks, maples, ashes and birches seek to outdo each other. These brilliant colours

contrast with the sombre dark greens of the evergreen pines, hemlocks and cedars. Life in the woods has slowed down, save for foraging parties of migrants that stay a day or two enroute south. Even the Robins and Chipping Sparrows are dispersing. The first of the breeders from further north, like the Dark-eyed Junco, appear. By the end of September none of the migratory species remain.

October is introduced by southward migrating flocks of geese; one wishes one could fly with them. Temperatures are now dropping. Fall colours linger on in the trees, usually until about the middle of the month. Then a sudden storm or petulant squall sends them cascading down. The resplendent red and gold are replaced by bare branches against a greying sky. October is, however, a splendid month for colourful fungi that emerge from the forest floor, and rotting logs and stumps. But, apart from this, there is little to see in the woods. One feels a distinct feeling of sadness as one shuffles along a familiar path, wading through a foot-high deposit of fallen leaves. The most obvious element in the fall woods are the Chipmunks. They now have the scene largely to themselves and make the most of it, calling, shrilling, as they undergo little chases through the leaves or sit sunning themselves on a log.

November is an unpleasant time in the woods and outdoors in general. The air is cold and clammy. The skies are commonly overcast. One has little desire to go hiking. There is nothing to see. The night falls early, morning comes late. There is not yet snow to give the winter experience. It is a 'between' time. One is depressed by the thought that the world is dead and that one must suffer a long 5-month winter before spring comes again.

The coming of the snow in December completes the annual cycle. Winter is a world unto itself. It has many faces. At worst it can be blizzards with everything obscured by a curtain of snow being driven hard by bitterly cold winds. It can be deep falls that block roads and paths. Mean January temperatures are -5 to -12 degrees Celsius (9-22 degrees F.) and minimum temperatures -22 to -30 degrees Celsius (-9 to -26 degrees F.). But there is also a beautiful side to winter; icicles hanging from the branches and sparkling pine needles, massive snowbanks, and frozen lakes. Snowshoeing on a mild and sunny winter's day is an exhilarating experience even though one may only see a few Chickadees, small Woodpeckers or a White-breasted Nuthatch, the trails of a fox or deer-mouse in the snow or a Porcupine sunning itself as it munches on the leafless buds of a birch.

Bird-watchers, of course, know how to make the most of winter. Feeders attract Chickadees, Hairy and Downy Woodpeckers, Nuthatches, Tree Sparrows from the north and Evening Grosbeaks from the west. One can go out for a trip to one of the islands in Lake Ontario (Wolfe or Amherst) and see the Snowy Owls and Rough-legged Hawks that winter there, feasting on the high populations of Meadow Voles under the snow. An expedition can be made on a cold winter night (an 'owl hoot') to try to locate Great Horned and Screech Owls. Winter is also, of course, a time to lay one's plans for the spring - and achieve a timetable that will enable one to enjoy it to the fullest without being overwhelmed with the rapidity of events once the snow melts.

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T H E B L U E B I L L

QUARTERLY BULLETIN
OF THE KINGSTON FIELD NATURALISTS

P.O. BOX 831
KINGSTON, ONTARIO
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2nd Class Registration No. 6310

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