Agriculture Canada

Research Branch | Direction générale de la recherche

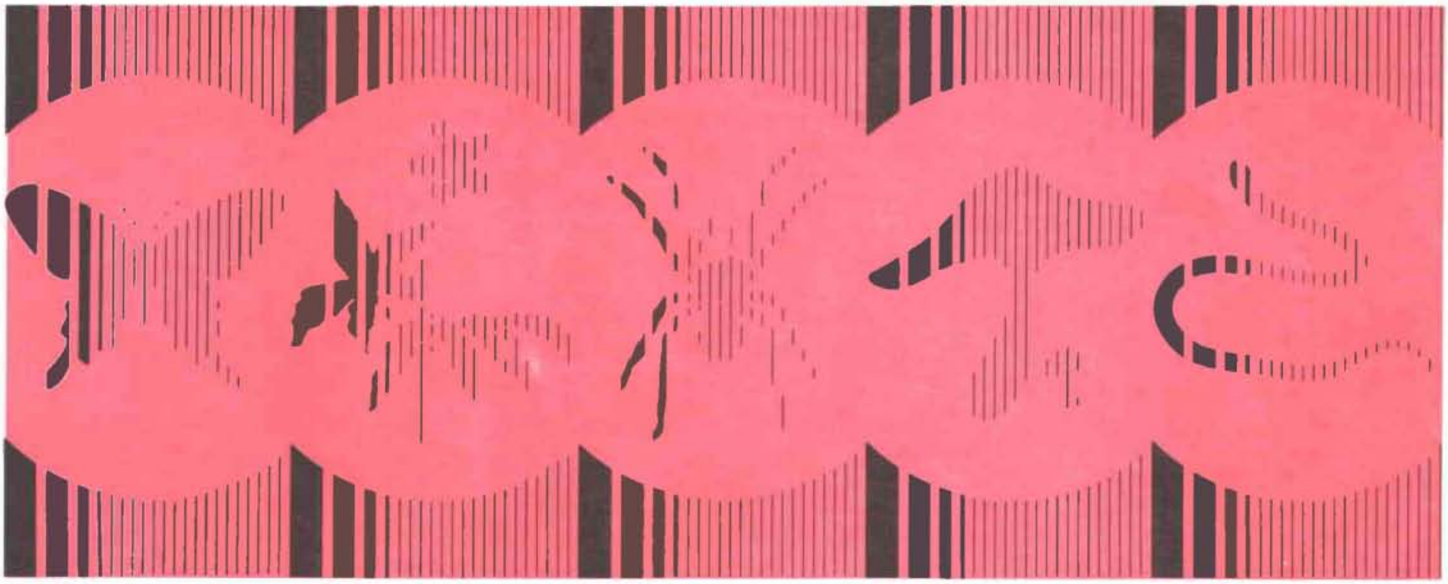
BRC Report 1 Rapport CRB

January, 1987

Biosystematics Research Centre

Centre de recherche biosystématique

The Insects, Spiders and Mites of Cape Breton Highlands National Park



Canada

THE INSECTS, SPIDERS AND MITES OF CAPE BRETON HIGHLANDS NATIONAL PARK

Edited by

J.D. Lafontaine, S. Allyson
V.M. Behan-Pelletier, A. Borkent
J.M. Campbell, K.G.A. Hamilton
J.E.H. Martin and L. Masner

Biosystematics Research Centre
Research Branch, Agriculture Canada

January 1987

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PART I INTRODUCTION

Arthropods form a large and fundamental component of nearly every community on earth. There are more species of arthropods than all other animals and plants combined and they occur in virtually every type of microhabitat. Unfortunately such a rich source of information is largely overlooked and uninterpreted. Cape Breton Highlands National park, until now, was no exception to these statements.

The following report provides a basis for an understanding of the arthropod community in the park. It is the result of a cooperative agreement between the Biosystematics Research Institute of Agriculture Canada and Cape Breton Highlands National Park of Parks Canada. Such a cooperative arrangement has many benefits for both organizations. It provides B.R.I. scientists with the opportunity to intensively collect and study the fauna of a previously poorly known area of Canada, and especially one that has already been recognized as an important area biologically. It is also an opportunity for scientists studying different arthropod groups to compare the fauna in terms of their understanding of other areas.

A major advantage of collecting in a National Park, over similar habitats in surrounding areas, is that studies of rare and unusual species can be continued in the future, and further collecting can be added to the data already accumulated, without fear that the areas being studied will be lost at a future date through habitat alteration or destruction. The advantage for Parks Canada of having a team of specialists study the arthropod fauna of a park is that it provides the park with a baseline study of what is usually the most poorly known portion of the fauna. As the arthropod faunas of more parks are studied, it will become easier to compare the faunas of various parks in Canada and better interpret the relative richness, diversity and importance of many habitats. Indeed, we strongly suspect that a well understood arthropod fauna will provide a much better appreciation that areas like Cape Breton Highlands National Park are highly complex and intricate ecosystems that fully justify our protection.

Previous to the collections made in Cape Breton Highlands National Park during the summers of 1983 and 1984, our knowledge of the arthropod fauna of the Park was based on small and selective collections made from time to time by visitors to the Park. During 1983 and 1984, a wide variety of collecting and trapping methods was used in all types of habitats in order to quickly obtain as much information on the arthropod fauna of the Park as possible.

The report is arranged in seven parts. The first part includes introductory material on collecting methods and localities. The second part is an overview of the fauna. Treatment of each taxonomic group includes an introduction and interesting aspects of the group including: common or characteristic species; rare or endangered species, or ones with disjunct ranges; detrimental and beneficial species; species first discovered in the Park or known in Canada only from the Park; and species that reach the edge of their range in the Park. The third part describes the characteristic and unusual arthropod species of the major habitats in the Park. The fourth part describes areas in the Park of special interest that contain an unusually high number of rare species, or are habitats that are particularly susceptible to damage through alteration or excessive use by Park visitors.

The fifth part discusses the significance of the Park in terms of the zoogeographical significance of the area, and the importance of special habitats represented and preserved within the Park.

The sixth part is a synthesis of the results of the survey, including a review of the significance of the Park arthropod fauna. The last part is a list of the 36 scientists that contributed sections of the report.

Acknowledgments

The Editors would like to extend a note of appreciation to the many individuals who have contributed to the preparation of this report. Those that have written sections of the report are listed in part seven. Bruce Cooper, Anthony Davies, Jocelyn Denis, Mary Dillon, Leo Forster, Carolyn Hill, Barbara Jinkinson, Wayne Lahey, James Poirier, Jim Redner, Eric Rickey, Robert Skidmore and King Wu assisted in the preparation and identification of material collected in the Park. Bruce Cooper, Anthony Davies, Mary Dillon and Jim Redner also collected in the Park during the survey. Diane Beauchamp, Cordelia Doren, Barbara Hilliker, Joanne Larocque and Rosanna Menchini assisted in the preparation and editing of the manuscript. Claude Paquette prepared the outline map of collecting localities. Photographs of insects were provided by Anthony Davies.

Collecting and trapping of specimens

by L. Masner

During the two seasons (1983, 1984) specimens of insects and arachnids were sampled by individual collecting or by trapping. The individual collecting was done throughout the Park in many places and habitats and it involved the following techniques: standard sweeping, screen sweeping, netting, sifting (also for Berlese funnels), manual picking, aquatic sampling (also with drift net), car netting, beating sheets, separation bag, bark peeling, rearing of specimens.

Trapping.

Traps of many kinds were usually set at the beginning of the season in particular locations in the Park and operated (maintained and emptied) throughout the season. Some traps were lost due to climatic or environmental hazards, rarely because of vandalism. Considerable material and a great wealth of ecological data was obtained.

Malaise trap. This is a collecting device for sampling of predominantly fast flying insects such as Diptera and Hymenoptera. Specimens are collected in alcohol and therefore are usually in good shape. These traps were operated in following localities: French lake 1984 (3 locations), Pleasant Bay 1984 (3 locations), North Mountain 1983-84, Lone Shieling 1983-84 (3 locations), Cheticamp flood plains, 1984, MacKenzie Mountain 1983-84, South Harbour 1983, South Harbour Campground 1983, Black Brook 1983.

Interception trap. This is a modified Malaise trap consisting of a low (120 cm) central panel, a roof, and a large plastic bottom trough with saline solution. The panel is treated with pyrethroid (Masner and Goulet 1981). The interception trap is designed for sampling small or slow flying insects, and is particularly useful in sampling certain groups of beetles and wasps. Several standard size as well as one extra large traps were used in the following localities: North Mountain 1983, MacKenzie Mountain 1983, Cheticamp flood plains 1984, Pleasant Bay 1984. An extra large trap was installed at Lone Shieling in 1983.

Light traps. Various models of light traps were used for sampling of nocturnal insects, Lepidoptera in particular. Light traps were operated in the Park at periods from spring to late summer in the following localities: Pleasant Bay 1983-84 (2 locations), Lone Shieling 1983, MacKenzie Mountain 1983, Black Brook 1984, Ingonish 1984.

Pitfall traps. Pitfall traps are designed to survey terrestrial species such as beetles, spiders, springtails, etc. They are usually roofed to prevent flooding from rains. Pitfall traps were used in the following localities: Paquets lake 1983 (10 traps), South Harbour 1983 (10 traps in sand bar), North Mountain 1983 (25 traps), MacKenzie Mountain 1983 (10 traps) and Lone Shieling 1983 (20 traps).

Pan traps. Pan traps have a similar purpose as pitfall traps but are usually wider and more shallow. Our pan traps were lined with yellow vinyl (larger size) or made of rigid yellow plastic (smaller size); they are filled with saline solution and a few drops of detergent to break the surface tension of the water. The localities surveyed were the same as those listed under pitfall traps; in addition, the following localities were explored: French Lake 1984 (5 traps), Cheticamp flood plains 1984 (22), Pleasant Bay 1984 (11 traps). Pan traps (4) were also placed among dead seaweed near Red River.

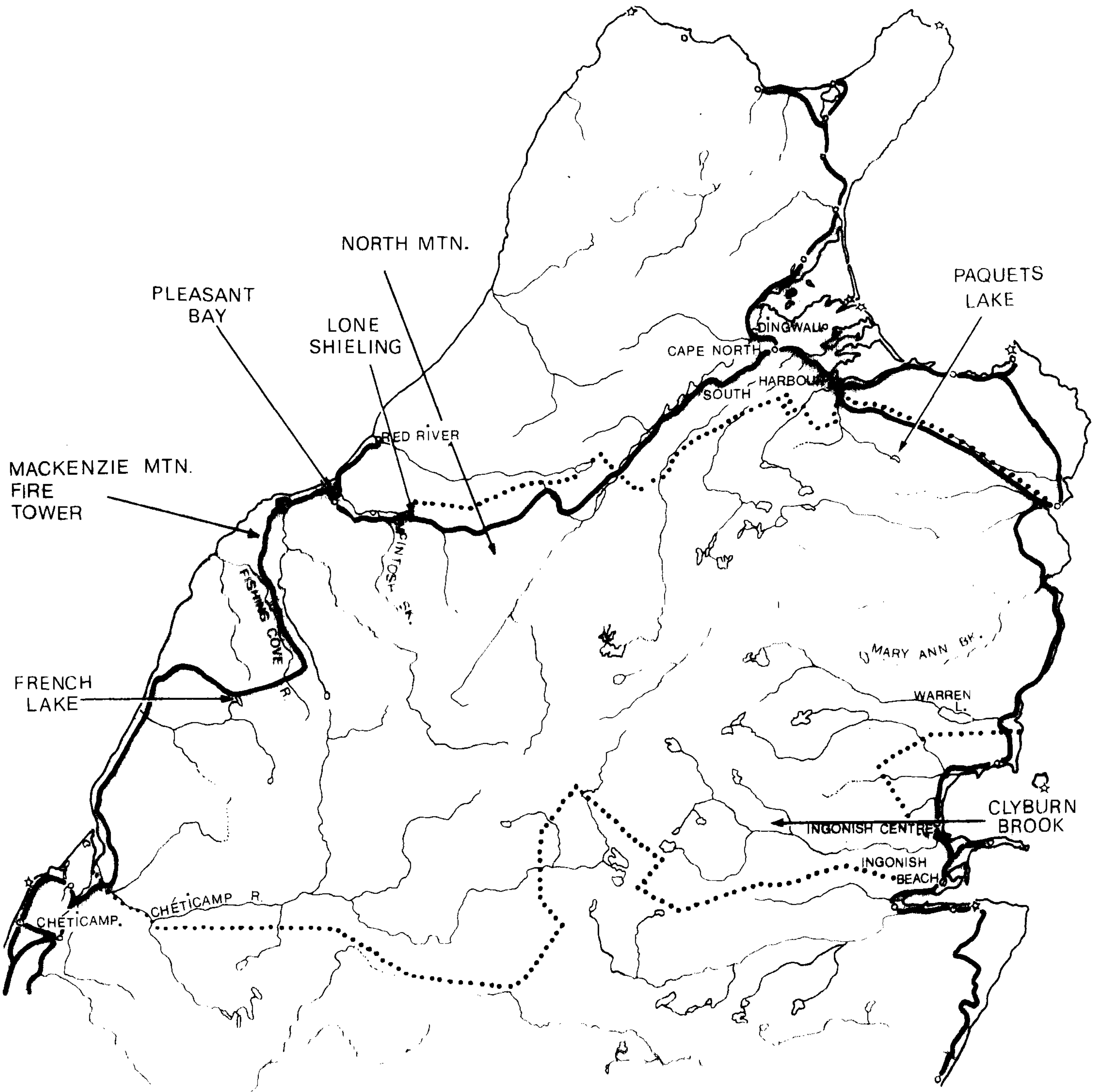
Descriptions of the above traps, and many others, and information on collecting and preparing of specimens can be obtained from Martin (1977).

A map showing the locations of the areas where traps were located and where most collections were made is given on the next page.

References

Martin, J.E.H. 1977. The insects and arachnids of Canada. Part 1. Collecting, preparing and preserving insects, mites and spiders. Agriculture Canada Publication 1643. 182 pp.

Masner, L. and H. Goulet. 1981. A new model of flight-interception trap for some hymenopterous insects. Entomological News 92: 199-202.



Map of major collecting localities and trap locations in CBHNP

PART II ARTHROPOD FAUNA OF CAPE BRETON HIGHLANDS NATIONAL PARK

Introduction

by J.D. Lafontaine

Arthropoda is a very large and diverse phylum of invertebrates characterized by segmented bodies, jointed appendages and a chitinous exoskeleton.

The Arthropods of Cape Breton Highlands National Park are classified in six classes. The two large classes, Arachnida (spiders and mites) and Insecta (insects), are treated in this report in detail. A brief account is given of three small classes: Diplopoda (millipedes), Chilopoda (centipedes), and Symphyla.

One class, the Crustacea, is omitted from this report since the study of this group is carried out by scientists at the National Museum of Natural Sciences. The crustaceans are primarily a marine group, although, one terrestrial group and at least four freshwater groups occur in the Park. The subclass Brachiopoda contains at least one, and possibly three, fresh water groups in the Park. Water fleas (Order Cladocera) are common in ponds, and clam shrimps (Order Conchostraca) and fairy shrimps (Order Anostraca) also probably occur in the Park. The subclasses Ostracoda and Mystacocardia each contain one freshwater group in the Park, the ostracods and copepods. The subclass Malacostraca includes one terrestrial group in the Park, the sowbugs (Order Isopoda) and one freshwater group, the scuds (Order Amphipoda); one additional group, the crayfish (Order Decapoda) could possibly occur also.

The class Arachnida includes five Orders in the Park: Araneae (spiders), Opiliones (harvestmen), Pseudoscorpionida (pseudoscorpions), Parasitiformes and Acariformes (mites and ticks). The three orders that include the spiders and mites contain the vast majority of the Parks' arachnid fauna.

Three groups within Insecta, namely Protura, Collembola (springtails) and Diplura are excluded from Insecta by some authors and are treated as distinct classes. Recent phylogenetic analyses of these groups, however, indicate that they should be included within Insecta.

Several thousand species occur in the Park representing twenty-seven orders of insects. The vast majority of species, however, are contained in four orders, namely Coleoptera (beetles), Diptera (flies), Lepidoptera (butterflies and moths), and Hymenoptera (sawflies, bees, wasps, ants, etc.). The next most important orders, in terms of numbers of species, are Odonata (dragonflies and damselflies), Grylloptera (crickets), Orthoptera (grasshoppers) Homoptera (hoppers, aphids, etc.), Hemiptera (true bugs), and Trichoptera (caddisflies). The remaining seventeen orders contain relatively few species and most of these are rarely observed by the non-specialist.

The following section is an overview of the arthropod fauna of Cape Breton Highlands National Park with particular emphasis on the four main orders of arachnids and the ten main orders of insects that occur in the Park.

Arachnida (spiders, pseudoscorpions, mites and ticks)

by V.M. Behan-Pelletier, C.D. Dondale,
E.E. Lindquist, M.J.Sharkey and I.M. Smith.

Arachnida are members of the subphylum Chelicerata, distinguishable from other arthropods by the presence of basically pincerlike or fanglike mouthparts, named chelicerae, and by the absence of antennae. The arachnid body is usually divided into two regions, a cephalothorax (prosoma) and an abdomen, although these divisions are not evident in most mites. The cephalothorax generally bears five other pairs of appendages besides chelicerae; the pedipalps, usually modified as raptorial or tactile devices, and four pairs of legs. There are often simple eyes on the cephalothorax. Arachnida are extremely diverse and have undergone extensive adaptive radiation in terrestrial and aquatic environments.

Four groups of Arachnida are represented in Cape Breton Highlands National Park: Acari (mites and ticks), Araneae (spiders), Pseudoscorpionida (pseudoscorpions) and Opiliones (harvestmen), of which the former three groups will be discussed.

Order Araneae (Spiders)

by C.D. Dondale

Spiders differ from other arachnids by the ability to produce silk from special glands within the abdomen, and by the possession, in adult males, of paired copulatory organs at the tips of the pedipalps. All spiders are predatory and are regarded by ecologists as a beneficial part of the fauna.

There are about 30,000 species of spiders in the world, of which an estimated 1,300 to 1,400 species occur in Canada. An area such as Cape Breton Highlands National Park may be expected to harbour at least 300 species, of which 233 have been recorded to date (Table 1). Collections of spiders in the Park were virtually nonexistent until 1983-84, when the B.R.C. survey was made. The main collecting methods used were pitfall traps of various kinds for ground dwellers, sweep nets and beating trays for herb, shrub, and tree dwellers, and sifters for litter and moss forms. Searches were also made under stones in fields, stream margins, talus slopes, and beaches, under loose bark on tree trunks, and on and inside buildings.

This report deals with 12 families of spiders, namely, the Theridiidae (cobweb or combfooted spiders), Araneidae, Tetragnathidae, and Theridiosomatidae (orb spiders), Agelenidae (funnel-web spiders), Hahniidae, Lycosidae (wolf spiders), Gnaphosidae (ground spiders), Clubionidae (sac spiders), Philodromidae and Thomisidae (crab spiders), and Salticidae (jumping spiders). Any of these may be noticed by people interested in natural history.

Family Theridiidae (Cobweb or Combfooted Spiders)

The cobweb spiders build three-dimensioned, "tangled" webs with little discernible pattern. They trap both flying and crawling prey. Although these spiders tend to be small (less than 5 mm in length excluding legs), they can cope with quite large prey by entangling it with silk flung from the spinnerets by the combed hind legs; hard insects are bitten and fed upon at the intersegmental membranes.

Ninety-three species are known in Canada, and 21 have been collected in Cape Breton Highlands National Park. Most of the kinds of cobweb spiders in the Park can be collected in trees and shrubs. Large numbers of the introduced *Enoplognatha ovata* (Clerck) and of the native *Theridion differens* Emerton and *Theridion frondeum* Hentz may be collected from these habitats. More rarely, the introduced *Theridion bimaculatum* (Linnaeus) and the native *Theridion sexpunctatum* Emerton, *Theridion aurantium* Emerton, *Theridion montanum* Emerton, *Theridion murarium* Emerton, *Theridion glaucescens* Becker, and *Theridula emertoni* Levi are seen. Forest litter or bogs yield *Euryopis argentea* Emerton, *Euryopis funebris* (Hentz), *Robertus banksi* (Kaston), *Robertus borealis* (Kaston), *Robertus riparius* (Keyserling), *Robertus fuscus* (Emerton), *Crustulina sticta* (O.P.-Cambridge), and *Enoplognatha marmorata* (Hentz). Specimens of *Steatoda borealis* (Hentz) are found in clumps of litter on beaches or along streams, and also in buildings; the related and introduced *Steatoda bipunctata* (Linnaeus) may displace *borealis* in buildings, abandoned boats, and similar places. Also found in buildings is the House Spider, *Achaearanea tepidariorum* (C.L. Koch).

Families Araneidae, Tetragnathidae, Theridiosomatidae (Orb Spiders)

The orb weavers of these three families build wheellike catching webs which are often seen suspended across open spaces between large herbs or between tree branches in late summer and autumn. Typically these webs consist of a framework of "spokes" radiating from the centre or hub, and these are connected by a continuous sticky spiral. The web is usually vertical or nearly so. It varies from a few centimetres to 80 cm or more in diameter according to the size of the spider, and is fastened at heights up to 2 m or more above ground, depending on the species of spider.

Ninety-seven species of orb-weavers are known in Canada, and 23 have been found in Cape Breton Highlands National Park. One of the most common forms is the small (5 to 7 mm) *Araniella displicata* (Hentz), which spins its web across the hollow of a single deciduous tree leaf. Also found among deciduous leaves are *Araneus iviei* (Archer), the Marbled Spider, *Araneus marmoreus* Clerck, and *Zygiella dispar* (Kulczynski). Herbs and shrubs harbour the Shamrock Spider, *Araneus trifolium* (Hentz), *Neoscona arabesca* (Walckenaer), *Eustala anastera* (Walckenaer), *Tetragnatha extensa* (Linnaeus), *Tetragnatha laboriosa* Hentz, *Tetragnatha versicolor* Walckenaer, and the minute *Theridiosoma gemmosum* (McCook). Conifers are preferred web sites for *Araneus nordmanni* (Thorell), *Cyclosa conica*

(Pallas), and *Nuctenea patagiata* (Clerck), and bogs for *Araneus groenlandicola* (Strand) and *Nuctenea cornuta* (Clerck). On buildings and breakwaters *Nuctenea sclopetaria* (Clerck) and *Zygiella atrica* (C.L. Koch) can be found, and litter yields *Hypsosinga rubens* (Hentz), *Hypsosinga pygmaea* (Sundevall), and *Pachygnatha brevis* Keyserling. A well-cover at South Harbour yielded a few individuals of the rare *Meta menardi* (Latreille). The banks of shaded streams are webbed by *Tetragnatha elongata* Walckenaer.

Family Agelenidae (Funnel-Web Spiders)

The webs of the funnel-web spiders are sheets of rather dense silk, with a network of tangling lines above and a funnellike opening at one side where the spider rests until a prey strikes the lines and falls on the sheet. The spider then grapples the prey and returns to the funnel with it. The funnel also serves as an exit when the spider is startled.

An estimated 65 species of Agelenidae are found in Canada, of which eight are known from Cape Breton Highlands National Park. Four species are rather small pale inhabitants of litter: *Cryphoeca montana* Emerton, *Cicurina brevis* (Emerton), *Cicurina pallida* Keyserling, *Cicurina robusta* Simon. Curls of bark on old birch trees are the lurking places of *Wadotes calcaratus* (Keyserling) and *Coras juvenilis* (Keyserling). Leaf-covered floors of deciduous forests, as well as fields and forest glades, are occupied by *Agelenopsis utahana* (Chamberlin and Ivie). Buildings are occupied by the cosmopolitan *Tegenaria domestica* (Clerck).

Family Hahniidae

Spiders of this family build sheet webs over small depressions on the soil surface and among grass roots. Some nine species occur in Canada, four of which are found in Cape Breton Highlands National Park. Litter in deciduous and coniferous forests yields *Neoantistea magna* (Keyserling), *Neoantistea agilis* (Keyserling), *Antistea brunnea* (Emerton), and *Hahnia cinerea* Emerton. Highland bogs also yield all four species. The two species of *Neoantistea* are, in addition, found in wrack on sea beaches and under litter on salt marshes.

Family Lycosidae (Wolf Spiders)

The Lycosidae, or wolf spiders, are the dark hairy spiders often seen wandering or darting over fallen leaves, sphagnum, rocks, and logs. They are largely day-active, using eyesight and rapid movements in prey detection and capture rather than webs. These are the only spiders that carry their egg sacs about on the spinnerets and their newly hatched young on the abdomen.

Ninety-nine species of lycosids are known in Canada, and 19 from Cape Breton Highlands National Park. Grasslands and forest openings are occupied in abundance by *Pardosa moesta* Banks, *Pardosa xerampelina* (Keyserling), *Pardosa fuscula* (Thorell), *Trochosa terricola* Thorell, *Alopecosa* *aculeata* (Clerck), *Arctosa rubicunda* (Keyserling), *Pirata piraticus* (Clerck), *Pirata insularis* Emerton, and, in smaller numbers, by *Pardosa distincta* (Blackwall), *Lycosa frondicola* Emerton, *Pirata minutus* Emerton, and *Pirata sedentarius* Montgomery. Bogs are the preferred habitat of *Pardosa hyperborea* (Thorell), *Arctosa raptor* (Kulczynski), *Pirata montanus* Emerton, and *Pirata canadensis* Dondale and Redner. Talus slopes and stony stream beds are the haunts of *Pardosa lapidicina* Emerton, and cobblestone beaches of *Pardosa groenlandica* (Thorell). Conifer forests and bogs yield many specimens of *Pardosa mackenziana* (Keyserling).

Family Gnaphosidae (Ground Spiders)

The gnaphosids, or ground spiders, mainly inhabit moist litter and are seldom seen except by disturbance of litter or the lifting of stones, logs, or other objects on the ground. When disturbed, they dart instantly for cover. All are hunting spiders.

One hundred and two species of gnaphosids are recorded in Canada, and 12 have been found in Cape Breton Highlands National Park. Widespread and numerous in many kinds of habitat in the Park are *Zelotes fratris* Chamberlin, *Gnaphosa parvula* Banks, and the antlike *Micaria pulicaria* (Sundevall). Restricted to fewer, moister habitats such as bogs and swamps are *Callilepis pluto* Banks, *Haplodrassus signifer* (C.L. Koch), *Haplodrassus hiemalis* (Emerton), *Micaria longispina* Emerton, an unknown species of *Micaria*, and *Drassodes neglectus* (Keyserling). Taken in both the highland barrens at Paquets Lake and in lowland conifer forest was *Gnaphosa muscorum* (L. Koch). Salt marshes and moist beach drift yielded *Sergiolus decoratus* Kaston. A motel at Pleasant Bay and an emergency shelter on the Aspy Trail harboured *Herpyllus ecclesiasticus* Hentz.

Family Clubionidae (Sac Spiders)

Clubionidae, or sac spiders, are dull-coloured hunters that roam nocturnally and spend the daylight hours in silk sacs in folded leaves or crevices in bark or litter. Females also lay their eggs in these sacs and may be observed there standing guard over their eggs in late summer. Some are litter dwellers, whereas others live in trees or shrubs.

Sixty-six species are known in Canada, and 17 in Cape Breton Highlands National Park. Common in the deciduous forest at Lone Shieling and in meadows are *Agroeca ornata* Banks, *Clubiona bishopi* Edwards, *Clubiona bryantae* Gertsch, *Clubiona canadensis* Emerton, *Clubiona johnsoni* Gertsch, *Clubiona kastoni* Gertsch, *Clubiona kulczynskii* Lessert, *Clubiona opeongo* Edwards, *Clubiona riparia* L. Koch, and *Clubiona trivialis* C.L. Koch. A talus slope in the valley of Clyburn Brook yielded *Agroeca pratensis* Emerton. Beach debris and salt marshes harbour *Castianeira descripta* (Hentz), *Clubiona norvegica* Strand, *Phrurotimpus borealis* (Emerton), and *Scotinella divesta* (Gertsch). The Cheticamp River flood plain produced *Phrurotimpus alarius* (Hentz), and a marshy meadow at Pleasant Bay *Scotinella pugnata* (Emerton).

Family Philodromidae (Crab Spiders)

The philodromids are crab spiders, hunters on foliage of trees and shrubs. Slender and lithe, they run swiftly and conceal themselves among the needles of conifers, in the folds and midribs of deciduous leaves, or along the stems of herbaceous plants.

Some 47 species occur in Canada, and 12 are known from Cape Breton Highlands National Park. Coniferous trees are the usual habitat for *Philodromus placidus* Banks, whereas deciduous foliage is somewhat favoured by *Philodromus rufus vibrans* Dondale. Mixed forests yield numbers of *Philodromus cespitum* (Walckenaer) and *Philodromus exilis* Banks. Ground habitats in open forests yield *Thanatus striatus* C.L. Koch and *Thanatus formicinus* (Clerck), whereas grassy meadows yield *Tibellus oblongus* (Walckenaer) and *Tibellus maritimus* (Menge). Sandy beaches are the main habitat of *Ebo pepinensis* Gertsch. Interception traps in wooded areas caught single specimens of *Philodromus mysticus* Dondale and Redner, *Philodromus praelustris* Keyserling, and *Philodromus vulgaris* (Hentz).

Family Thomisidae (Crab Spiders)

The thomisids are also called crab spiders, but their bodies are even more crablike than those of the Philodromidae. Strong and somewhat ponderous, these hunters move tanklike over the substrate, and grapple prey with the much enlarged two front pairs of legs. Most are drably coloured like litter, but a few are brightly coloured and lurk in flowers where they capture pollenating insects, or among the needles of conifers.

There are 63 species of Thomisidae in Canada, and 11 in Cape Breton Highlands National Park. Widespread in the litter of deciduous and coniferous forests, and also of flood plains and moist meadows are *Xysticus emertoni* Keyserling, *Xysticus luctuosus* (Blackwall), *Xysticus ferox* (Hentz), and *Ozyptila distans* Dondale and Redner. The flood plain of the Cheticamp River yielded specimens of *Xysticus elegans* Keyserling, and sedge meadows and beaches yielded small numbers of *Xysticus discursans* Keyserling. Bogs harbour *Ozyptila sincera canadensis* Dondale and Redner, and a salt marsh produced a single specimen of *Ozyptila gertschi* Kurata. Conifer foliage yielded *Xysticus punctatus* Keyserling and *Coriarachne utahensis* (Gertsch). Flowers on many kinds of plants produced specimens of the Goldenrod Spider, *Misumena vatia* (Clerck).

Family Salticidae (Jumping Spiders)

The Salticidae, or jumping spiders, are often seen hopping, running, or sunning on the foliage and stems of plants. They hunt by sight. A few species live in litter or in stony places such as beaches and the margins of stream beds.

Approximately 100 species are known in Canada, and 16 species are represented in Cape Breton Highlands National Park. Found mainly on plants were *Sitticus palustris* (Peckham and Peckham), an unnamed species of *Sitticus* that is also found elsewhere in eastern Canada, *Metaphidippus flavipedes* (Peckham and Peckham), *Metaphidippus canadensis* (Banks), *Metaphidippus montanus* (Emerton), *Metaphidippus protervus* (Walckenaer), *Evarcha falcata* (Clerck), and *Eris marginata* (Walckenaer). Litter in bogs and marshes produced *Sitticus striatus* Emerton, *Talavera minuta* (Banks), and *Neon nellii* Peckham and Peckham. Beaches and sometimes stony stream beds yield *Habronattus borealis* (Banks), *Habronattus waughi* (Emerton), and *Habrocestum pulex* (Hentz). Wooden debris on beaches and wooden buildings shelter *Salticus scenicus* (Clerck), which may also occasionally appear in pitfall traps in deep forest. The barren at Paquets Lake yielded a single specimen of *Habronattus decorus* (Blackwall).

Table 1. Census of Cape Breton Highlands National Park Spiders

Family	No. species known in Canada	Estimated no. species in Park	No. species known in Park
Dipluridae	4	0	0
Atypidae	1	0	0
Antrodiaetidae	3	0	0
Mecicobothriidae	1	0	0
Loxoscelidae	2*	0	0
Scytodidae	1	0	0
Telemidae	1	0	0
Dysderidae	3*	0	0
Segestriidae	2*	0	0
Pholcidae	3*	1	0
Agelenidae	65*	11	8
Hahniidae	9	4	4
Amaurobiidae	25	6	4
Dictynidae	60*	10	5*
Theridiidae	93	37	21
Linyphiidae	136*	44	30*
Erigonidae	309*	80	50*
Uloboridae	3	1	0
Oecobiidae	1	0	0
Theridiosomatidae	1	1	1
Araneidae	72	26	17
Tetragnathidae	24	10	5
Mimetidae	6*	1	1*
Nesticidae	1	1	0
Pisauridae	7	4	0
Lycosidae	99	22	19
Oxyopidae	2	1	0
Gnaphosidae	102	18	12
Clubionidae	66	32	17
Anyphaenidae	6	1	0
Philodromidae	47	16	12
Thomisidae	63	18	11
Salticidae	100*	22	16
Total	1,318*	365	233*

* - estimate

Subclass Chelonethida
Order Pseudoscorpionida (pseudoscorpions)

by M.J. Sharkey

Pseudoscorpions are small terrestrial arachnids from 1 to 7 mm in length that prey on small insects and other arthropods. They resemble true scorpions but are generally much smaller and lack a postabdomen and sting. As with scorpions they have a large pair of chelate pedipalps that are used primarily to grasp prey; in most pseudoscorpions these are equipped with poison glands. The first pair of appendages, the chelicerae, are used for grooming and to macerate food; however, they also possess silk glands. Pseudoscorpions construct silken chambers when brooding their young, when hibernating and when moulting.

Pseudoscorpions pass through 2 embryonic and 3 nymphal stages before reaching adulthood. Nymphs resemble adults but are smaller, lighter in coloration and have fewer sensory hairs. As in many arthropod groups, sperm transfer is indirect. Males often construct elaborate spermatophore webs to direct females to sperm.

Most pseudoscorpions are active throughout the spring, summer and fall and hibernate in winter when they retreat deep into the soil. They prefer moist habitats and are most common in forest litter, in rotten logs, on the undersides of rocks and under the bark of dead or dying trees.

Only four species of pseudoscorpions have been captured in the park. These are *Chelifer cancroides* L., *Microbisium brunneum* (Magen), *Microbisium confusum* (Hoff) and *Pseudogarypus banksi* (Jacot). Undoubtedly, there are more species that occur in the park, perhaps as many as 10 species. Hoff (1949) gives keys to and descriptions of the pseudoscorpions found in the state of Illinois. His paper includes most species likely to be encountered in Cape Breton.

Chelifer cancroides (L.), a species common in the park, is cosmopolitan in distribution and associated with man and his dwellings. Specimens are sometimes found on human hair and clothing; it is not known if they are searching for food such as lice, or are using humans as a means of dispersal. The habit of one animal using another as a means of dispersal is termed phoresy and is practised by many pseudoscorpions. Pseudoscorpions are often found on other insects, especially flies and beetles. They use their strong pedipalps to secure a hold on these insects.

Microbisium confusum is the pseudoscorpion most commonly encountered in the park. It occurs in litter and in rotting logs on the floor of mixed forests. A closely related species, *M. brunneum*, occurs in the moss and debris of bogs. *Pseudogarypus banksi* was frequently found under the bark of dead spruce.

Subclass Acari (mites and ticks)

by V.M. Behan-Pelletier, E.E. Lindquist, I.M. Smith

Introduction

Acari (mites and ticks) are the most diverse and species rich group of Arachnida. They can be distinguished from other members of the class by the body usually lacking traces of segmentation and by the presence of a pair of subcapitular rutella in most groups. They can be distinguished from members of the class, other than Ricinulei by the presence of a six-legged larva. They are among the smallest of arthropods, with adults generally ranging in body size from 0.1 to 1mm, and occasionally to about 5mm; some engorged ticks, however, may be up to 20mm.

Few animal groups show the diversity in form , habitat and behaviour seen in the Acari. They are more ubiquitous than insects, having successfully colonized every known terrestrial, marine and freshwater habitat. They occur from polar desert to tropical lowland; in leaf litter; in surface and deep mineral soil; in cold and hot springs; in streams, ponds, lakes and seawater; as ectoparasites of insects, other arthropods, reptiles, birds and mammals; in genital cavities of wasps and in the cloacal cavities of turtles; in bird feathers, in facial pores of people and on all kinds of fungi and plants (Lindquist 1979).

The basic life history of mites and ticks is that after hatching from the egg there is a six-legged larva, followed by 2 or 3 eight-legged instars and an eight-legged adult, but almost every variation on this pattern is possible. Gall mites have only one larval and one nymphal stage with two pairs of legs, as in the adult; adult female pyemotid mites give birth directly to adult females and males; argasid ticks have as many as eight nymphal moults.

Among the Arachnida only the mites and ticks have feeding strategies other than predation or scavenging. They include not only predators, but also plant feeders, parasites, parasitoids, and associates of arthropods, reptiles, birds and mammals. In addition some are saprophagous and many are fungivorous.

Acari are of great economic importance. Plant feeding mites are among the most important pests of fruits and many are pests of field crops. Mites feeding on stored products in granaries and warehouses cause heavy financial loss. Some species are important household pests causing allergies and dermatitis. Parasitic forms, such as ticks, chiggers, scabies mites and mange mites, are of medical and veterinary importance, both because they carry disease organisms and because of their damaging effects on the host. In contrast, many species are beneficial as predators, and some as parasitoids, in the integrated control of phytophagous mites and small insect pests, and a few as plant-feeders in the biological control of weeds. Many soil mites are essential in the decomposition and humification of leaf litter and other organic material and in the recycling of nutrients.

There are estimated to be between 250,000 and 300,000 species of Acari in the world, with 10,000 estimated to occur in Canada. With its bird and mammal fauna and its variety of habitats Cape Breton Highlands National Park must harbour approximately 1,500 species. Collections of Acari from the Park were virtually non-existant before the present survey. In fact, the mite fauna of Nova Scotia in general is poorly known, there being only two published records with information on mites in general (Rasmy and MacPhee 1970, Wright 1979). Acari are represented in the Park by the groups: Gamasida, Ixodida, Oribatida, Acaridida and Actinedida.

Order Parasitiformes
Suborder Gamasida (or Mesostigmata)

by E.E. Lindquist

The Gamasida constitutes a large group of mites ranging in size from 200 to about 2000um, but commonly around half a millimeter. Using a hand lense, or a low-powered field microscope, one can often discern the typical body structure of these mites, with 1 or 2 pale to dark brown dorsal plates, and usually several smaller, similarly-colored ventral plates, separated by whitish membranous cuticle. Under greater mganification, two other characteristics are evident - the palpi terminating with a pair of reduced claws, and the pair of lateral stigmata on the body, above the bases of legs II to IV, from each of which a usually elongated peritreme projects anteriorly in postlarval instars to aid in respiration. Gamasid mites have only 3 immature instars (1 larval, 2 nymphal), all of which are usually active. Their life cycle varies from as short a period as 1 or 2 weeks for some species to a year for others. Adult males do not deposit stalked spermatophores on inert substrates; instead, although they lack an aedeagus, they engage in some sort of copulatory activity to transfer sperm packets or droplets directly to adult females. Adult females lack an eversible ovipositor, but nevertheless lay their relatively large eggs singly, without protective covering, onto a suitable substrate. Further information on these mites, and a comprehensive introduction to the literature on them, is presented in Krantz' manual (1978).

Gamasid mites are basically a predatory group, feeding on nematodes, small insects, and other kinds of mites in a variety of terrestrial, arboreal, subcortical, nidicolous, and subaquatic habitats throughout the world. Some, however, have adapted to feeding on pollen or fungi, or as parasites on insects. Many members of the large superfamily Dermanyssoidea have evolved from nidicolous associates of birds and mammals to facultative or obligate blood-feeding parasites of their hosts.

Representatives of about 40 families of Gamasida have been recorded from Canada (Lindquist 1979). Members of about 33 of these families probably occur in Cape Breton Highlands National Park and surrounding areas of Cape Breton Island, Nova Scotia; to date, 18 have been recorded, mostly from collecting done during the present survey (Table 2). The families that have not yet been recorded consist largely of parasitic mites of vertebrates, which were not collected during this survey. The varied habitats of the Park are expected to harbor approximately 225 species, representing about 100 genera, of Gamasida, of which about 70 species, representing 46 genera, have been collected to date (Tables 2 and 3). The collecting method used for Gamasida in the Park was extraction in Berlese-Tullgren funnels of mites from habitat samples of leaf litter, soil, decaying wood, loose bark, mosses, lichens, grasses and herbs; sampling for mites from the nests of vertebrates, and from the vertebrates themselves, was not undertaken.

Members of several of the families of free-living Gamasida are of interest in habitats found on Cape Breton Island. Mites of a species of the sejoid genus *Sejus* (formerly called *Liroaspis*) live in rotting wood and forest litter, and are conspicuous by their relatively large bodies (adults nearly 1mm in length) which bear several orange-brown, tuberculated dorsal plates and terminate with 1 or 2 pairs of long, seta-bearing tubercles. Their feeding habits are unknown.

The veigaiid genus *Veigaia* is well represented in the Park. About 25 species of *Veigaia* are known in North America (Farrier 1957, Hurlbutt 1984), of which the records of 6 species in the Park are thought to indicate nearly the northern extent of an eastern North American fauna of 19 species of this genus. Seven species have been collected from Kouchibouguac National Park in New Brunswick, of which 6 are the same as those collected from Cape Breton.

Some 20 species of phytoseiid mites of the genera *Amblyseius, Euseius, Phytoseius* and *Typhlodromus* occur on trees, shrubs, and in the ground litter of forests and fields in the Park. Various previous records of these mites in Nova Scotia have been published (Rasmy and MacPhee 1970, Chant and Hansell 1971, Chant *et al.* 1974). Some of them are of real importance in the natural control of plant-feeding mite pests of conifers and of rosaceous trees and bushes including apple, cherry and raspberry (McMurtry *et al.* 1970).

Mites representing 5 genera of Parasitidae (*Holoparasitus, Gamasodes, Pergamasus, Parasitus, Poecilochirus*) are recorded or anticipated to live in the Park. These mites are not, as the family name implies, parasites but instead are generally free-living predators of other small arthropods. The second nymphal instar of some parasitid mites may commonly be found riding on adult insects with which they live harmoniously and use as transports to move from a deteriorating substrate to a fresh one (Binns 1982). For example, nymphs of some *Poecilochirus* species are found on *Necrophorus* carrion beetles, and both undergo their life history in carrion (Springett 1968); nymphs of some *Parasitus* species are found on bumble bees, and these mites complete their development within the bees' nests (Richards & Richards 1976).

About 20 species of mites representing 2 genera of Digamasellidae (*Dendrolaelaps, Insectolaelaps*) and 12 of Ascidae (*Arctoseius, Iphidozercon, Zerconopsis, Asca, Gamasellodes, Antennoseius, Platyseius, Cheiroseius, Lasioseius, Neojordensia, Orthadenella, Proctolaelaps*) are recorded from the Park. Of these, material of 1 species of *Proctolaelaps*, collected amidst lichens and moss on bark of an old red oak tree, is notable in representing a new species collected for the first time. Some digamasellid and ascid mites are common associates of bark- and woodboring-beetles. Again, the mites are carried (the digamasellids as second nymphs, but the ascids as female adults) by dispersing adult beetles, and they undergo their life histories in the galleries formed by their hosts under bark. The ascid, *Mucroseius monochami* Lindquist (misidentified as *Proctolaelaps hystrix* in some recent papers), and several species of the digamasellid genus *Dendrolaelaps* (which are not yet recorded from the Park but are certain to occur there) have a close association with sawyer beetles of the genus *Monochamus*, of which the northeastern sawyer, *M. notatus* (Drury), and whitespotted sawyer, *M. scutellatus* (Say), are common on Cape Breton Island. Curiously, one finds these mites phoretic in very localized positions on the adult beetles, and correlated with the presence of nematodes, within the thoracic and abdominal spiracles of the beetle carriers (Tamura and Enda 1980). These mites evidently prey on the nematode associates, both while being carried on the beetles, and also in the tunnels made in coniferous wood by the beetles and their larvae, where the mites continue their life cycle.

Ascid mites of the subfamily Platyseiinae are unusual in having adapted to living in subaquatic habitats in marshes, bogs, and in moss partially submerged in streams and springs. Some members of this subfamily are notable among mites in having structural adaptations for plastron respiration while submerged in water (Hinton 1971). Five species in 2 genera (*Platyseius*, *Cheiroseius*) are recorded from the Park. These mites are thought to be predators, but their prey are generally unknown; in one case they were observed floating on mosquito egg rafts and preying on individual eggs and hatching larvae in Algonquin Park, Ontario (B.P. Smith 1983). Adult females are carried by various subaquatic flies, primarily crane flies, from one water system to another.

Ameroseiid mites are notable in having adapted to feeding on pollen grains and fungal spores. In the Park, 1 species of *Ameroseius* was collected from bark of a standing dead birch tree; mites of this genus commonly live in bracket fungi which develop on such trees. Adult females are carried by the tenebrionid beetle, *Bolitotherus cornutus* (Panzer), from deteriorating brackets to fresh ones.

Mites representing 2 genera of Zerconidae (*Parazercon*, *Zercon*), and 1 of Ologamasidae (*Gamasellus*) are recorded from the Park; little is known about these mites, which live in moss, humus, and forest litter. Only 1 species and genus each of the eviphidoid families Macrochelidae (*Macrocheles*), Parholaspidae (*Neparholaspis*), Pachylaelapidae (*Pachylaelaps*) and Eviphididae (*Thinoseius*) have been collected from the Park, though a considerably more diverse representation of these families is thought to exist there. Eviphidid mites are associated with insects in edaphic habitats of pastures and meadows, and in seashore debris (*Thinoseius*). Macrochelids also live in various soil habitats; some are associated with synanthropic flies in organic debris, and a few are potentially important in the biological control of manure-inhabiting flies (Krantz 1983). Parholaspid and pachylaelapid mites live in humus, moss, compost, rotting wood, and carrion; some may be associated with ants.

About 10 species of free-living or insect-associated mites representing 5 genera of Laelapidae are recorded from the Park (*Hypoaspis, Cosmolaelaps, Laelaspis, Pseudoparasitus, Ololaelaps*). Some members of the first 4 genera are associated with insects, especially ants. Members of *Ololaelaps* appear to favor damp habitats, yet they have also been recorded from nests of small mammals.

Of the families of Dermanyssoidea that are parasitic on vertebrates which occur in the Park, macronyssid mites may be found on birds, bats, rodents, and snakes, hirstionyssid and laelapid mites on small mammals, dermanyssid mites on birds, rhinonyssid and halarachnid mites in the respiratory passages of birds and mammals (including seals), respectively, and spinturnicid mites on bats. Certain of these dermanyssoid mites, including the northern fowl mite, *Ornithonyssus sylviarum* (Canestrini and Fanzago), the chicken mite, *Dermanyssus gallinae* (DeGeer), and the related *D. hirundinis* (Hermann), are serious pests of domestic fowl and other birds such as martins and swallows, for which people provide artificial nesting sites. These mites also bite people, causing itching and skin irritation, but they will not remain with them as an alternate host to birds. Most of these mites have yet to be recorded from the Park because surveys have not included special methods of collecting for parasitic arthropods on vertebrate hosts or for the nest-dwelling arthropod associates of vertebrates. However, they are certain to occur in the Park along with their hosts, and a variety of them have been recorded from elsewhere in Nova Scotia, especially the Tobeatic Game Sanctuary adjacent to Kejimkujic National Park (Wright 1979).

A major subgroup of the Gamasida, the Uropodina, or tortoise mites, is probably represented by mites of 5 families in the Park; however, these have been inadequately surveyed. These mites live in a great variety of soil, subaquatic, subcortical, nidicolous, rotting wood, and dung habitats. Their feeding habits are poorly known: some are apparently scavengers, others are thought to feed on fungal hyphae, spores, and pollen, and still others may prey on nematodes and immobile or slow-moving forms of arthropods (Hughes 1976). Many are associated with insects; while in the second nymphal stage, they are especially adapted for attaching themselves, by means of an anally-secreted stalk, to adult insects which carry them from deteriorating substrates to fresh ones. Representatives of only 4 genera of Polyaspidoidea and Uropodoidea are recorded from the Park. Of these, *Iphidinychus*, collected from a sample of wet sedges, sphagnum and labrador tea litter, is notable as the first record of this genus of Polyaspidoidea from eastern Canada; this may be another example of a nearly northernmost extension in distribution of an eastern North American faunal element. This genus has rarely been recorded since its original description over 70 years ago, which was based on material collected in moss from "Columbia" (North America).

Suborder Ixodida (or Metastigmata) - ticks

by E.E. Lindquist

Ticks are a small group of acarines in terms of number and diversity of species; however, as individuals they are among the largest of acarines, ranging in size from 1 to 5 mm as unfed adults, and up to 20 mm when fully engorged. With a hand lens or a low-powered field microscope, one can discern some of the characteristics of ticks - their leathery bodies, their mouthparts with a projecting, beaklike hypostome armed with recurved teeth, their palpi with the two most apical segments fused and lacking claws, a pair of prominent, roundish, respiratory stigmata located laterally on the body near the bases of legs IV and lacking peritremes.

Ixodid or hard ticks have only 2 immature stages (1 larval, 1 nymphal), whereas argasid or soft ticks have a larva followed by a nymph that may undergo 2 to several molts which do not appear to differ from each other morphologically. The life cycle of ticks in Canada typically takes from a half to a full year. Adult males use their mouthparts to effect transfer of sperm from their genital opening directly into the female's genital opening. Adult females lack an eversible ovipositor; eggs are layed in batches, in relatively smaller numbers (10 - 50) at a time, but repeatedly, by argasids, and in large numbers (hundreds or thousands) and generally only once by ixodids.

Ticks are obligate blood-sucking parasites of terrestrial mammals, birds, and to a lesser extent reptiles. All active instars harm their hosts due to the direct effect of their bites, to secondary infection at attachment sites, and to transmission of disease-causing pathogens. In Canada, the effects of ticks are less injurious to animals, including people and livestock, than in warmer regions. However, tick paralysis is sometimes a serious, potentially lethal condition in cattle, which is caused by salivary substances injected while the ticks feed, rather than by a pathogen. This condition is caused by the Rocky Mountain wood tick, *Dermacentor andersoni* Stiles, which does not occur in eastern Canada. *Dermacentor* ticks are vectors of Rocky Mountain Spotted Fever and tularaemia in eastern and western areas, but fortunately the strains of the former in Canada are usually of low pathogenicity to people, and both diseases respond to antibiotics. *Ixodes cookei* Packard may be a vector of Powassan virus in the east, but clinical cases in Canada are rare.

The Ixodida comprises 3 families, of which 1 is monobasic and known only from Africa. The other 2 have a worldwide distribution except for subpolar and polar regions. In Canada, perhaps 10 species of Argasidae are thought to occur in southern areas, all in the West except for *Ornithodoros kelleyi*, mentioned below. About 30 species of Ixodidae (including Amblyomminae which is treated separately as a family by a few authors) occur in Canada, some approximately as far north as treeline; of 15 species thought to occur in eastern Canada, 10 are anticipated to be found in Cape Breton Park (Tables 2 and 3). Only 3 of these species have actually been recorded from Cape Breton Island, but the others almost certainly occur with their hosts there, based on reported collection records elsewhere in Nova Scotia (Gregson 1956, Wright 1979).

In southeastern Canada, the winter tick, *Dermacentor albipictus* (Packard), attacks deer, moose, and range horses, more severely so in winter and early spring on animals limited to park areas and game farms. The American dog tick, *Dermacentor variabilis* (Say), is perhaps the most prevalent tick in Nova Scotia, and frequently bites dogs and to a lesser extent people, and also small rodents, deer, livestock, and coyotes; this is the eastern counterpart of *D. andersoni*, and is the important eastern vector of spotted fever. The rabbit tick, *Haemaphysalis leporispalustris* (Packard), recorded from Cape Breton Island, feeds primarily on rabbits but also on other small rodents and birds; it rarely bites people. Although not yet recorded from the Island, *Haemaphysalis chordeilis* (Packard) is parasitic on grouse and other gallinaceous birds which occur there. A species introduced from Europe and recorded from the Island, the brown dog tick, *Rhipicephalus sanguineus* (Latreille), attacks primarily dogs and probably coyotes, and secondarily rabbits, deer, and occasionally people. *Ixodes uriae* White, recorded from Cape Breton, is a parasite of marine birds such as auks, murres, puffins, and cormorants. Five other species of *Ixodes* ticks are anticipated to live on Cape Breton Island where their hosts occur: *I. banksi* Bishopp on beaver and muskrat; *I. marxi* Banks on squirrels; *I. angustus* Newmann on various rodents; *I. muris* Bishopp and Smith on small rodents; and *I. cookei* Packard which, in addition to being found in nature on various medium-sized mammals, especially carnivores, frequently bites people.

No argasid ticks have been reported for eastern Canada. However, an argasid bat tick, *Ornithodoros kelleyi* Cooley and Kohls, is known from central Minnesota and the Niagara area of New York; since it commonly parasitizes the little brown bat, *Myotis lucifugus* (LeConte), which is found on Cape Breton Island, it probably occurs with this host on the Island also.

Table 2. Superfamilies and Families of Gamasida and Ixodida Represented in Cape Breton Highlands National Park

	Estimated No. of species in Canada	Estimated No. of species in Park	No. of species recorded from Park
Suborder Gamasida			
Cohort Sejina			
Sejoidea	(5)*		
1. Sejidae	2	1	1
Cohort Gamasina			
Epicrioidea	(100)		
2. Zerconidae	90	10	4
Parasitoidea	(150)		
3. Parasitidae	135	23	9
4. Veigaiidae	15	7	6
Rhodacaroidea	(150)		
5. Rhodacaridae	25	3	0
6. Ologamasidae	30	4	1
7. Digamasellidae	70	10	2
8. Halolaelapidae	25	3	0
Eviphidoidea	(100)		
9. Eviphididae	25	3	1
10. Macrochelidae	40	8	1
11. Parholaspidae	20	2	1
12. Pachylaelapidae	15	2	1
Ascoidea	(280)		
13. Ascidae	150	35	17
14. Phytoseiidae	100	20	10
15. Otopheidomenidae	5	1	0
16. Ameroseiidae	25	4	1
Dermanyssoidea	(200)		
17. Laelapidae	100	20	9
18. Haemogamasidae	15	5	2
19. Dermanyssidae	5	2	0
20. Macronyssidae	15	4	0
21. Rhinonyssidae	40	10	0
22. Halarachnidae	10	2	0
23. Entonyssidae	3	1	0
24. Ixodorhynchidae	8	1	0
25. Spinturnicidae	5	1	0
Cohort Uropodina			
Thinozerconoidea	(1)		
26. Protodinychidae	1	1	0
Polyaspidoidea	(35)		
27. Polyaspididae	30	4	2
28. Dithinozerconidae	5	2	1

Uropodoidea	(250)		
29. Uropodidae	240	30	3
30. Trachyuropodidae	10	2	0
Cohort Antennophorina			
Antennophoroidea	(2)		
31. Antennophoridae	2	1	0
Celaenopsoidea	(10)		
32. Celaenopsidae	2	1	0
33. Diplogyniidae	5	2	0
Total	1268	225	72
Suborder Ixodida			
Argasoidea	(10)		
1. Argasidae	10	1	0
Ixodoidea	(30)		
2. Ixodidae	30	10	3
Total	40	11	3

* Numbers in parentheses for superfamilies may include other families represented elsewhere in Canada but not on Cape Breton Island.

Table 3. Genera of Gamasida and Ixodida
Represented in Cape Breton Highlands National Park

	Recorded from Cape Breton Island	Anticipated on Cape Breton Island
Gamasida		
Sejidae		
Sejus	x	
Zerconidae		
Parazercon	x	
Zercon	x	
Caurozercon		x
Parasitidae		
Holoparasitus	x	
Gamasodes	x	
Pergamasus	x	
Parasitus		x
Poecilochirus		x
Veigaiidae		
Veigaia	x	
Rhodacaridae		
Rhodacarus		x
Rhodacarellus		x
Ologamasidae		
Gamasellus	x	
Cyrtolaelaps		x
Euryparasitus	x	
Digamasellidae		
Dendrolaelaps	x	
Insectolaelaps	x	
Multidendrolaelaps		x
Dendrolaelaspis		x
Longoseius		x
Halolaelapidae		
Saprolaelaps		x
Halolaelaps		x
Eviphididae		
Thinoseius	x	
Alliphis		x
Copriphis		x
Marochelidae		
Macrocheles	x	
Geholaspis		x
Parholaspidae		
Krantzholaspis	x	
Pachylaelapidae		
Pachylaelaps	x	
Pachyseius		x
Ascidae		
Arctoseius	x	
Iphidozercon	x	

Zerconopsis	x	
Platyseius	x	
Cheiroseius	x	
Asca	x	
Gamasellodes	x	
Protogamasellus		x
Antennoseius	x	
Lasioseius	x	
Blattisocius		x
Orthadenella	x	
Neojordensia	x	
Proctolaelaps	x	
Mucroseius		x
Phytoseiidae		
Phytoseius	x	
Typhlodromus	x	
Euseius	x	
Amblyseius	x	
Otopheidomenidae		
Otopheidomenis		x
Ameroseiidae		
Ameroseius	x	
Kleemannia		x
Laelapidae		
Hypoaspis	x	
Cosmolaelaps	x	
Laelaspis	x	
Pseudoparasitus	x	
Ololaelaps	x	
Androlaelaps	x	
Laelaps		x
Hyperlaelaps		x
Ondatralaelaps		x
Myonyssus		x
Dichrocheles		x
Haemogamasidae		
Haemogamasus	x	
Eulaelaps	x	
Dermanyssidae		
Dermanyssus		x
Hirstionyssus		x
Macronyssidae		
Macronyssus		x
Ornithonyssus		x
Steatonyssus		x
Rhinonyssidae		
Rhinonyssus		x
Sternostoma		x
Ptilonyssus		x
Rhinoecius		x
Larinyssus		x

Halarachnidae		
Halarachne		x
Zumptiella		x
Entonyssidae		
Ophiopneumicola		x
Ixodorhynchidae		
Ixodorhynchus		x
Spinturnicidae		
Spinturnix		x
Protodinychidae		
Protodinychus		x
Polyaspididae		
Polyaspis	x	
Trachytes	x	
Dithinozerconidae		
Dithinozercon		x
Iphidinychus	x	
Uropodidae		
Dinychus		x
Prodinychus	x	
Uropoda		x
Trichouropoda		x
Cilliba		x
Oodinychus	x	
Uroobovella		x
Discourella		x
Phaulodinychus	x	
Uroactinia		x
Trachyuropodidae		
Oplitis		x
Antennophoridae		
Antennophorus		x
Celaenopsidae		
Pleuronectocelaeno		x
Diplogyniidae		
Diplogynium		x
Total	46	53

Ixodida		
Argasidae		
Ornithodoros		x
Ixodidae		
Ixodes	x	
Dermacentor		x
Haemaphysalis	x	
Rhipicephalus	x	
Total	3	2

Order Acariformes
Suborder Oribatida (or Cryptostigmata)

by V.M. Behan-Pelletier

Oribatida (Oribatei or Cryptostigmata) is a large and diverse group, comprising the so-called 'beetle', 'box' or 'moss' mites, which range from 100-1500um, but commonly around half a millimetre, in size. Using a hand lens, or field microscope one can distinguish them from other Acari by their brown to black, sclerotized bodies which can be heavily and beautifully sculptured in some groups. Some families, however, are poorly sclerotized and are almost white in colour. With greater magnification two other characteristics become evident: the mouthparts, adapted for feeding on fungi and decaying organic matter, are usually covered and protected by the anterior margin of the prosoma, and hence are invisible from above; and the anterior dorsal surface of the body generally carries a pair of large, distinctive, sensory setae that arise from cupshaped structures called bothridia.

Oribatid mites have a worldwide distribution and are even found in large numbers in arctic and antarctic regions. They occur in salt and fresh water, caves, rodent burrows, nests above and below ground, on trees and in human dwellings, but they are most common in litter and soils, where population densities may reach 500,000 per square metre (Behan *et al.* 1978).

In addition to the adult, oribatid mites typically have 4 active free-living immature instars (1 larval, 3 nymphal) which are all less sclerotized and, morphologically, generally quite different from the adult. The length of their life cycle varies from a few months to several years depending on the species involved and the microclimatic and habitat variables. In adults of most groups, males and females are similar in external appearance. Mating is indirect, that is, the male deposits a stalked spermatophore. Females subsequently locate the spermatophores and pick up the sperm packets with their genital valves, leaving the stalks behind. In some species, males guide the females to spermatophores. The female lays her eggs through an extrusible ovipositor onto a suitable substrate.

Oribatid mites are one of the most important faunal components of most soils, particularly in undisturbed and forested habitats. They affect litter decomposition by dispersing fungi and by stimulating senescent fungal colonies through grazing. Many spores pass undigested through their guts, giving rise to new fungal colonies. In addition, the mites carry fungal spores, most of which are viable, on their setae and body surfaces. They indirectly affect soil formation and, ultimately, growth of roots and seed germination by vertical movement of organic matter to deeper soils, humus formation and comminution of plant residues. Certain macrophytophages, for example, eating dead branches lying on the forest floor, produce faecal pellets consisting of finely shredded woody tissue. Some Oribatida concentrate nutrients, in particular calcium, in their heavily sclerotized exoskeleton, which can be important in slowing the leaching of these nutrients from soils. Many oribatid species are associated with plants, feeding on various living parts of higher plants, including pollen. Some species can damage the root systems of commercial crops. Many species are of veterinary importance because of their role as intermediate hosts of tapeworms. Some species are predators on other small soil arthropods and nematodes and they may be important in controlling populations of soil nematodes. Further information on these mites, and a comprehensive introduction to the literature on them, is presented in Krantz' manual (1978).

Representatives of 75 families of Oribatida occur in this country; of these, about 69 are known from eastern Canada (Marshall *et al.* 1987). About 70 families are expected to occur in Cape Breton Highlands National Park, and to date 67 have been recorded. An area as diverse in habitats as the Park may be expected to harbour approximately 350 species of Oribatida of which 154 have been collected to date representing 97 genera (Tables 4 and 5). Collections of oribatid mites from Nova Scotia were virtually non-existant before the present survey. As a result most of the named species collected in the Park are new records for Nova Scotia. The main collecting method used was the extraction of Oribatida from litter, soil, decaying and dead wood, loose bark, moss, lichens, seaweed, and grasses in Berlese-Tullgren funnels. Oribatida were also collected from pitfall traps and sweep nets.

The palaeacaroid, parhypochthonioid, cosmochthonioid, brachychthonioid and atopochthonioid mites differ from most other oribatids in having no or weak sclerotization as adults. The species *Gozmanyina majestus* (Marshall and Reeves), a tiny mite with long, decorative setae, previously collected only in moist coniferous litter in Ontario and Québec, is found in the drier parts of bogs in the Park. *Atopochthonius artiodactylus* Grandjean, also known from Ontario and Québec, was found in moss and lichens on the barrens. Members of the mesoplophoroid, phthiracaroid and euphthiracaroid superfamilies, mites that can close the prosoma over the abdomen somewhat like a flick-knife, and when closed look like seeds, are very abundant in forest litter. There some of them feed on the decaying parts of higher plants, hollowing out spruce needles, for example, and leaving the space packed with faecal pellets (Jacot 1939). The first record of the superfamily Perlohmannioidea, genus *Perlohmannia*, in eastern Canada was collected at Lone Shieling. Members of this genus are known to feed on living roots (Evans *et al.* 1961).

The crotonioid species *Platynothrus peltifer* (C.L. Koch) is indicative of moist habitats in the Park, for example, in wet moss on rocks beside running water, and in the wetter parts of bogs where it is probably feeding on moss and algae. It shares this habitat with other crotonioid genera - such as *Trimalaconothrus* and *Malaconothrus*. The Hermannioidea were unknown from eastern Canada until specimens of the species *Hermannia subglabra* Berlese were found in large numbers in beach vegetation at South Harbour. As the habitat implies, this species is very tolerant of saline conditions and it has been found in similar habitats in the Yukon, Northwest Territories and Alaska as well as in western Europe. In saline marshes *H. subglabra* shares the habitat with the ceratozetoid species *Diapterobates notatus* (Thorell), a species with an arctic and subarctic distribution throughout the Northern hemisphere, and occasionally with the mycobatid *Pelopsis bifurcata* (Ewing), which is widely distributed throughout the eastern United States (Norton 1979), but has only been recorded in Canada from the Northwest Territories. As the habitat becomes increasingly tidal only specimens of *H. subglabra* are found.

Gustavioid mites are well represented in the Park with 11 species in 7 genera recorded so far. *Hafenferrefia nitidula* (Banks), previously known only from New Hampshire (Norton 1983), was collected in spruce and fir litter close to Pleasant Bay. An undescribed species of *Cultroribula* was found in alder litter at Ingonish. A species near *Dorycranosus acutidens* (Aoki) and an undescribed species of *Liacarus* are the most common oribatids in the very dry pine, alder and juniper litter close to Ingonish Beach. These Oribatida are particularly large, being a millimetre or more in length, and very shiny; yet this is one of few published records of these genera from eastern Canada. Different species in these genera, however, are found in similar habitats in western North America and Alaska. An astegistid species, *Furcoribula furcillata* (Nordenskjold), which prior to this survey was only known from Illinois and Europe, is very abundant in the lichens and flaking bark on the trunks of maple trees at Lone Shieling. This species may be semi-arboreal, seldom occurring in litter, which might explain why its distribution is so poorly known.

The cepheoid genus *Eupterotegaeus* is generally common in forest litter in western North America but rare in collections from eastern North America. An undescribed species in this genus, close to *E. spinatus* Woolley and Higgins, is quite widespread throughout the Park, being found in moist spruce and red oak litter and in moss. Eremaeid mites prefer dry habitats where they feed on lichens and fungi. They are comparatively abundant in the Park in crowberry and buffaloberry litter, on the cliffs at the end of the Skyline Trail for example, in drier forest litter, and on the trunks of maple trees.

Many species in the carabodoid genus *Carabodes* are more common on tree trunks and in the crown of trees than in litter. They form part of a very diverse, but poorly known, arboreal oribatid fauna which includes species in the oripodoid genera *Dometorina* and *Eporibatula*. The *Carabodes* species probably feed on lichens on the trunks and branches of trees. A preference for dry habitats also extends to litter dwelling species of *Carabodes*. They are among the most abundant mites in the dry depauperate litter on the rocky barrens, above Glasgow Lake for example, but extremely rare in bogs. In fact, the records of this genus from bogs in the Park are probably individual specimens that have fallen from the branches of tamarack or black spruce at the edge of the bog. The discovery of an undescribed species of *Tegeocranellus* in the carabodoid family Tectocepheidae, among the roots of sedges at the lagoon at Ingonish, is an exciting find as this is the first record of this genus in Canada, and there are no published records of this genus in North America. In addition, this marshy habitat is similar to that described for the type-species of the genus from Italy. Species in this genus are well adapted for their semiaquatic habitat by having platelike extensions of the body above legs 2 and 3, which, when the mite is submerged, hold an air bubble that supplies oxygen to the mite's respiratory system. They share this capability, of taking their own 'air tank' with them when submerged, with the hydrozetoid family Hydrozetidae. The Hydrozetoidea, as the name implies, are true aquatic mites. They are represented in the Park by species in the genera *Hydrozetes* and *Limnozetes*, and are found in the wetter parts of bogs and in wet moss by the edge of streams.

The Oripodoidea is one of the most important groups of Oribatida in the Park as species in the xylobatid genus *Xylobates* are found in virtually all forest litter and grassy habitats. Species in the scheloribatid genus *Scheloribates* are found in all terrestrial habitats, except those that are very saline. The predominantly arboreal genera *Dometorina* and *Eporibatula* have been already noted. *Rostrozetes foveolatus appalachicola* Jacot, a haplozetid species and genus previously unknown in Canada, is the most abundant oribatid in the North Mountain bog. Although this mite is only about half a millimetre in size, it is very distinctive with its yellow-brown, strongly pitted exoskeleton. It may be feeding on the decomposing outer sheaths of the roots of sedges and pitcher plants.

Species in the ceratozetoid genus *Chamobates* are also very widely distributed in the Park. An undescribed species near *Chamobates subglobulus* (Oudemans) is the most abundant species among flaking bark and lichens on the trunks of maple trees, a habitat it shares with *Furcoribula furcillata* (Nordenskjold), yet neither of these species is found in the moss and litter at the bases of the same trees. In fact, the deciduous forest litter harbours another species of *Chamobates*, as do the crowberry litter and lichens in the rocky barrens of the Park. The genus *Heterozetes* in the ceratozetoid family Zetomimidae is almost semiaquatic, and *H. aquaticus* (Banks) is abundant in habitats in the Park where *Hydrozetes* and *Tegeocranellus* occur. The first and only record of this genus in Canada, prior to this survey, was from a beaver house in Gatineau Park, Québec. In addition, an undescribed species in this genus is abundant in the wetter parts of the bogs in the Park. There are five species of *Ceratozetes* in the Park: *C. cuspidatus* (Jacot), which is a constant component of deciduous forest litter but also occurs in the barrens, *C. gracilis* (Michael) and *C. mediocris* Berlese, which are only found in moist deciduous litter, *C. thienemanni* Willmann, which is only found in balsam fir and black spruce litter, and an undescribed species from bog vegetation. All four described species have an extensive distribution throughout Canada with *C. thienemanni* having a boreal - subarctic distribution, which is in accordance with its distribution in the Park.

Two other ceratozetid species, *Sphaerozetes arcticus* Hammer and *Melanozetes longisetosus* Hammer, were only known from the arctic and subarctic of North America prior to this survey. In the Park, they are found in only one habitat, wet moss on rocks at the edge of swiftly flowing streams, for example the branches of the Aspy River. These species also prefer moist to wet habitats in the arctic and subarctic but not necessarily near flowing water. Their restricted occurrence in the Park suggests that their distribution may be limited by temperature. The lichens and flaking bark on the trunks of maple trees also harbour undescribed species in the mycobatid genera *Mycobates* and *Minuthozetes*, the latter genus being unknown from

Canada prior to this survey. In contrast to these two genera, which prefer dry habitats, the mycobatid genus *Punctoribates* occurs in wet habitats. There is an undescribed species of this genus in the Park bogs, and another species in the marshy areas at Ingonish.

One of the more exciting finds in the Park is a new species of *Unduloribates*, in the family Unduloribatidae, suborder Phenopelopoidea. This is the first record of the family from Canada, and there are no published records of this family in North America. This genus is known from the Himalayas and alpine areas in the Soviet Union. It is the most abundant oribatid in the rocky barrens and is also found in crowberry litter along sea cliffs. An abundant oribatelloid mite in the rocky barrens is the tegoribatid species *Scutozetes lanceolatus* Hammer, again a species only known from the arctic and subarctic prior to this survey. The occurrence of this species in the barrens and that of *Sphaerozetes arcticus* and *Melanozetes longisetosus* by swift flowing streams are the only indications of an arctic-subarctic component in the Park's oribatid fauna. The most southerly recorded distribution for *S. lanceolatus* is northern Québec and Labrador.

In addition to the occurrence of *Hafenferrefia nitidula* in deciduous litter in the Park, the presence of the following achipteriids in the same biotope is a strong indication of an 'appalachian' component in the Park's oribatid fauna: *Parachipteria travéi* Reese-Nevin, *Achipteria catskillensis* Reese-Nevin, *A. clarencei* Reese-Nevin and a new species of *Dentachipteria*. Prior to this survey these species and the genus *Dentachipteria* were only known from the Appalachian region of northeastern U.S.A. *A. clarencei* may be another species associated with lichens and flaking bark on tree trunks; though it occurs in maple and beech litter, it is particularly abundant on the trunks of maple trees.

Table 4. Superfamilies and Families of Oribatida known or expected to occur in Cape Breton Highlands National Park.

Superfamily and Family	No. species known from eastern Canada	Estimated No. of species in Park	No. species recorded from Park
Archeonothridae			
1. Archeonothridae	0	1	0
2. Acaronychidae	0	1	0
Palaeacaroidea			
3. Palaeacaridae	1	2	1
Hypochthonioidea			
4. Hypochthoniidae	1	2	1
5. Eniochthoniidae	1	2	1
Cosmochthonioidea			
6. Cosmochthoniidae	1	1	1
Brachychthonoidea			
7. Brachychthoniidae	20	1	5
Atopochthonioidea			
8. Atopochthoniidae	1	1	1
9. Pterochthoniidae	1	1	0
Mesoplophoroidea			
10. Archoplophoridae	1	1	1
11. Mesoplophoridae	0	1	0
Parhypochthonioidea			
12. Parhypochthoniidae	1	1	1
13. Gehypochthoniidae	1	1	0
Phthiracaroidea			
14. Phthiracaridae	6	12	8
Euphthiracaroidea			
15. Oribotritiidae	0	2	1
16. Euphthiracaridae	3	6	3
Eulohmannioidea			
17. Eulohmanniidae	1	1	1
Epilohmannioidea			
18. Epilohmanniidae	1	2	0
Perlohmannioidea			
19. Perlohmanniidae	0	1	1
Crotonioidea			
20. Nothridae	3	3	2
21. Camisiidae	8	9	6
22. Trhypochthoniidae	2	3	2
23. Malaconothridae	2	5	3
Nanhermannioidea			
24. Nanhermanniidae	2	2	2
Hermannioidea			
25. Hermanniidae	0	1	1
Hermannielloidea			
26. Hermanniellidae	1	2	1

Liodoidea			
27. Liodidae	0	1	0
Plateremaeoidea			
28. Gymnodamaeidae	0	6	1
29. Licnodamaeidae	0	1	1
Damaeoidea			
30. Damaeidae	2	15	2
Cepheoidea			
31. Cepheidae	2	6	2
Amerobelboidea			
32. Eremulidae	0	1	0
33. Damaeolidae	0	1	0
34. Eremobelbidae	2	1	0
Eremaeoidea			
35. Eremaeidae	1	5	3
Gustavioidea			
36. Tenuialidae	0	1	1
37. Liacaridae	1	8	5
38. Xenillidae	0	1	0
39. Astegistidae	2	4	4
40. Metrioppiidae	2	2	1
41. Gustaviidae	1	1	0
Carabodoidea			
42. Carabodidae	2	7	6
43. Tectocepheidae	1	4	3
Thyrisomoidea			
44. Oppiidae	9	20	13
45. Suctobelbidae	6	18	4
46. Autognetidae	2	2	1
47. Caleremaeidae	1	1	0
48. Thyrisomidae	2	2	2
Hydrozetoidea			
49. Hydrozetidae	0	2	1
50. Limnozetidae	0	3	2
Oripodoidea			
51. Xylobatidae	2	6	2
52. Protoribatidae	0	2	1
53. Oribatulidae	7	14	7
54. Haplozetidae	2	5	2
55. Scheloribatidae	2	8	3
56. Oripodidae	0	2	0
57. Parakalummidae	2	5	3
Ceratozetoidea			
58. Chamobatidae	1	7	4
59. Zetomimidae	0	3	2
60. Ceratozetidae	13	20	12
61. Mycobatidae	4	10	6
Phenopelopoidea			
62. Phenopelopidae	3	8	3
63. Unduloribatidae	0	1	1

Oribatelloidea			
64. Oribatellidae	2	3	2
65. Tegoribatidae	2	3	2
66. Achipteriidae	1	15	8
Galumnoidea			
67. Galumnidae	3	10	2
Total	138	310	155

Table 5. Genera of Oribatida Represented in Cape Breton Highlands National Park

Family	Genus	Recorded from Park	Anticipated to occur in Park
Archeonothridae	*Zachvatkinella*		x
Acaronychidae	*Acaronychus*		x
Palaeacaridae	*Palaeacarus*	x	
Hypochthoniidae	*Hypochthonius*	x	
Eniochthoniidae	*Hypochthoniella*	x	
Cosmochthoniidae	*Gozmanyina*	x	
Brachychthoniidae	*Brachychthonius*	x	
	Eobrachychthonius		x
	Liochthonius	x	
	Mixochthonius		x
	Sellnickochthonius	x	
	Synchthonius		x
Atopochthoniidae	*Atopochthonius*	x	
	Pterochthonius		x
Archoplophoridae	*Archoplophora*	x	
Mesoplophoridae	*Mesoplophora*		x
Parhypochthoniidae	*Parhypochthonius*	x	
Gehypochthoniidae	*Gehypochthonius*		x
Phthiracaridae	*Atropacarus*	x	
	Hoplophorella	x	
	Hoplophthiracarus	x	
	Phthiracarus	x	
Oribotritiidae	*Mesotritia*		x
	Oribotritia	x	
Euphthiracaridae	*Euphthiracarus*	x	
	Microtritia	x	
	Rhysotritia	x	
Eulohmanniidae	*Eulohmannia*	x	
Epilohmanniidae	*Epilohmannia*		x
	Epilohmannoides		x
Perlohmanniidae	*Perlohmannia*	x	
Nothridae	*Nothrus*	x	

Camisiidae	*Camisia*	x	
	Heminothrus(Heminothrus)	x	
	Heminothrus(Platynothrus)	x	
Trhypochthoniidae	*Trhypochthonius*	x	
	Trhypochthoniellus	x	
Malaconothridae	*Malaconothrus*	x	
	Trimalaconothrus	x	
Nanhermanniidae	*Nanhermannia*	x	
Hermanniidae	*Hermannia*	x	
Hermanniellidae	*Hermanniella*	x	
Liodidae	*Liodes*		x
Gymnodamaeidae	*Gymnodamaeus*	x	
	Adrodamaeus		x
Licnodamaeidae	*Licnodamaeus*	x	
Damaeidae	*Belba*		x
	Caenobelba		x
	Damaeus		x
	Epidamaeus	x	
Cepheidae	*Cepheus*	x	
	Eupterotegaeus	x	
	Oribatodes		x
Eremulidae	*Eremulus*		x
Damaeolidae	*Fosseremus*		x
Eremobelbidae	*Eremobelba*		x
Eremaeidae	*Eremaeus*	x	
Tenuialidae	*Hafenferrefia*	x	
Liacaridae	*Adoristes*	x	
	Dorycranosus	x	
	Liacarus	x	
Xenillidae	*Xenillus*		x
Astegistidae	*Cultroribula*	x	
	Furcoribula	x	
Metrioppiidae	*Ceratoppia*	x	
Gustaviidae	*Gustavia*		x
Carabodidae	*Carabodes*	x	
	Podopterotegaeus	x	
	Odontocepheus		x
Tectocepheidae	*Tectocepheus*	x	
	Tegeocranellus	x	
Oppiidae	*Berniniella*	x	
	Cosmoppia	x	
	Insculptoppia	x	
	Oppia	x	
	Oppiella	x	
	Oxyoppia	x	
	Quadroppia	x	
	Subiasella	x	
Suctobelbidae	*Suctobelba*	x	
	Suctobelbella	x	
Autognetidae	*Autogneta*	x	

Thyrisomidae	*Banksinoma*	x	
Hydrozetidae	*Hydrozetes*	x	
Limnozetidae	*Limnozetes*	x	
Xylobatidae	*Xylobates*	x	
Protoribatidae	*Liebstadia*	x	
Oribatulidae	*Dometorina*	x	
	Eporibatula	x	
	Oribatula	x	
	Zygoribatula	x	
	Phauloppia	x	
Haplozetidae	*Peloribates*	x	
	Rostrozetes	x	
Scheloribatidae	*Scheloribates*	x	
Oripodidae	*Oripoda*		x
Parakalummidae	*Neoribates*	x	
	Parakalumma		x
Chamobatidae	*Chamobates*	x	
Zetomimidae	*Heterozetes*	x	
Ceratozetidae	*Ceratozetes*	x	
	Fuscozetes	x	
	Diapterobates	x	
	Melanozetes	x	
	Sphaerozetes	x	
	Trichoribates	x	
Mycobatidae	*Minuthozetes*	x	
	Mycobates	x	
	Pelopsis	x	
	Punctoribates	x	
Phenopelopidae	*Eupelops*	x	
	Propelops	x	
Unduloribatidae	*Unduloribates*	x	
Oribatellidae	*Oribatella*	x	
Tegoribatidae	*Lepidozetes*	x	
	Scutozetes	x	
Achipteriidae	*Achipteria*	x	
	Anachipteria	x	
	Dentachipteria	x	
	Parachipteria	x	
Galumnidae	*Galumna*	x	
	Pergalumna	x	
Total		122	96

Order Acariformes
Suborder Acaridida

by V.M. Behan-Pelletier

The Acaridida is a large group of slow-moving, weakly sclerotized mites ranging in size from 200 to 1500um. Under the microscope they look like juvenile Oribatida but can be distinguished from them and other types of acariform mites by having only two palpal segments and none of the sensory setae arising from cupshaped sockets, called bothridia, on the propodosoma. In addition, the male has a sclerotized aedeagus and insemination is direct. These mites usually have four active immature instars (larva, protonymph, deutonymph, tritonymph); the deutonymph (hypopus) is unlike other instars, however, being modified for phoresy, or to withstand adverse conditions. It has no mouth or functional gut, is dorsoventrally flattened and well sclerotized, and the posterior region of the body is modified for attachment. In most species the protonymph molts into either a deutonymph and subsequently into a tritonymph or directly into a tritonymph depending on environmental conditions.

Acaridid mites are worldwide in distribution and occupy a broad range of nonpredatory niches. They occur in ephemeral habitats such as decaying organic materials, insect nests, vertebrate nests and subcortically. They are best known as pests of stored products and members of some species may cause dermatitis in humans who handle contaminated foodstuffs. A large number, however, are parasites of birds, mammals, insects and crustaceans. Some species are freeliving in all stages and are saprophagous and fungivorous.

There has been no specialized collecting for Acaridida in Cape Breton Highlands National Park and nothing is as yet known of the Park's acaridid fauna; we can, however, make some predictions.

As there are approximately 100 species of breeding birds and 40 species of mammals in the Park, we can estimate that the Acaridida are represented by at least 420 species of bird associates and 30 mammal associates. There are many more birds than mammal associates as bird mites are more host and niche specific than mammal associates. To date, however, only 37 of the estimated 2,100 species of bird and mammal associates have been recorded from Canada (Lindquist *et al.* 1979). Some interesting groups of Acaridida which we anticipate to occur in the Park are the following.

Because of their highly modified mouthparts, anoetid mites of the superfamily Anoetoidea live primarily as filter feeders of microorganisms in wet edaphic, semiaquatic and other moist substrates, one species living in the pitchers of insectivorous *Sarracenia* plants. Members of another species, known from Michigan, are predators or parasites of earthworm eggs.

Members of the superfamily Glycyphagoidea are mainly associated with small rodents and insectivores, but some species are found on birds and insects. In many species associated with mammals the hypopus is parasitic within the hair follicle or in the dermal layers, where it obtains nutrients from the host and in some cases can grow ten-fold before leaving the host. Some species are intermediate hosts of rodent tapeworms.

Psoroptoid mites, common in Canada, are associated with the hair and skin of mammals. They can be pests of economic importance, causing mange. Pyroglyphid mites are nidicoles of both birds and mammals, feeding on skin debris, feathers, hairs, and other nest debris. Some are responsible for house-dust allergies in people. Small carnivores are often attacked by the ear mite, *Otodectes cynotis* (Hering), which causes intense irritation in the external auditory canal.

Although almost unknown from Canada, members of the Sarcoptoidea and Cytoditoidea are undoubtedly common on most species of birds and mammals. They are dermal, subdermal, respiratory and visceral parasites and cause mange and scabies on mammals, and scaly-leg and damage to the lungs and nasal cavities in birds. The sarcoptid mite *Notoedres cati* (Hering), a common cause of mange in cats, also occurs on squirrels and rabbits. The depluming mite *Mesoknemidocoptes laevis gallinae* (Railliet) burrows into the skin at the base of the feathers in chickens and geese, producing intense irritation, and the feathers either fall out or break off. Some species inhabit the respiratory tract of rodents, and others are internal and external parasites of bats.

We can conservatively estimate that there are 300 species of feather mites (Analgoidea and Pterolichoidea) in Cape Breton Highlands National Park. They occur on the contour, wing and tail feathers and in the quills of flight feathers, and there may be up to five species of feather mites on the plumage of an individual bird. Luckily, few are considered of economic importance.

Order Acariformes
Suborder Actinedida (or Prostigmata)

by Ian M. Smith

Actinedida is a large and very diverse group of mites ranging in size from 100 to 1000um, and represented in virtually every type of habitat throughout the world. Although the group is rather difficult to characterize using obvious structures, in most species the stigmata are located anteriorly on the body, typically between the bases of the chelicerae. Most actinedids are small and soft-bodied when compared to mites of other suborders, but all can be discerned using a good hand lens. The most readily observed forms in Cape Breton Highlands National Park are the relatively large, reddish-coloured erythraeid and velvet mites which frequent forest litter and herbaceous plants, and their relatives the water mites.

Actinedid mites basically have 4 active, free-living immature instars (1 larval, 3 nymphal) in addition to the adult, but in various groups the life history has been modified through the specialization or suppression of certain instars as mentioned below. In adults of many groups the sexes are similar and mating involves deposition by males of spermatophores which subsequently are located and picked up by females. However, in some groups more elaborate patterns of mating behaviour have evolved involving direct transfer of spermatophores from males to females, and in many of these groups the males are highly modified structurally.

Actinedida exhibit a very broad range of feeding habits including predation, fungivory, phytophagy, parasitism, parasitoidism, and saprophagy.

Some 89 families of Actinedida are known to occur in Canada (Smith and Lindquist 1979), and members of all but 8 of these have been collected in the eastern part of the country. Over 800 species representing 78 families should be found in Cape Breton Highlands National Park. To date members of 53 families have been recorded from within the boundaries of the Park, and representatives of an additional 13 families have been discovered in nearby parts of the Atlantic provinces.

Superfamily Pachygnathoidea.

This group appears to paraphyletic, including early derivative taxa related to both actinedid and oribatid mites. These tiny, soft bodied mites can be found in soil, litter, and moss habitats throughout the Park, but are especially abundant in litter samples from higher elevations. Little is known of their biology, although members of at least some species of *Nanorchestes* feed on algae (Schuster and Schuster 1977). Individuals of one species of *Bimichaelia* inhabiting lichens and moss on tree bark in the Park are large enough to be discovered by careful searching and observation with a good hand lens.

Superfamily Eupodoidea.

Members of this group are small to moderately large mites found in soil, litter, and moss habitats throughout the Park. Ghostly white predaceous Rhagidiidae, including the largest representatives of this group, can readily be observed moving quickly on damp, cool surfaces of stones or wood that have been in contact with the ground. The specimens of *Shibaia* sp. collected in the Park are the first of this genus reported from Canada. Fungivorous Eupodidae are usually small and inconspicuous, although members of certain genera can be noticed on damp, protected soil surfaces, and recognized by distinctive features such as the extremely long front legs of *Linopodes* spp. and the jumping behaviour of *Eupodes* spp. and *Cocceupodes* spp. Penthaleidae and Penthalodidae feed on herbaceous plants, and are represented in the Park by one uncommon species of each family. The penthaleids collected in the Park appear to belong to an undescribed species and genus. Members of many species of this superfamily are adapted to live in damp, cold, barren microhabitats, and the group is especially well represented in litter habitats in upland regions of the Park.

Superfamily Tydeoidea.

This group of small, soft-bodied mites is represented in the Park by a diverse assemblage of Tydeidae and a few species of Ereynetidae. The most common tydeids are probable predators belonging to various species of *Tydeus*, found on plant foliage and in litter throughout the Park, and plant feeders such as *Afrotydeus lindquisti* (Marshall) and *Pretydeus kevani* (Marshall), inhabiting mossy litter among herbaceous plants, especially on sandy soils. The erynetids collected thus far in the Park are predators in the genus *Ereynetes*, but members of other genera probably occur there as parasites and associates of molluscs and vertebrates and invertebrates.

Superfamily Bdelloidea.

Predaceous snout mites are found in litter and occasionally arboreal habitats in all regions of the Park. Bdellids such as members of *Cyta latirostris* (Hermann), *Bdella muscorum* Ewing and *Bdellodes* (*Octobdellodes*) sp., and cunaxids of species such as *Cunaxa setirostris* (Hermann) are common in upland regions, while individuals of other cunaxid species exemplified by *Bonzia halacaroides* Oudemans and *Pseudobonzia reticulata* (Heryford) are typical inhabitants of wet, mossy litter at lower elevations.

Superfamily Halacaroidea.

This group is mainly marine, but members of a few genera are restricted to fresh water habitats. The biology of these mites is largely unknown. Although no specimens have been collected in the Park as yet, specialized sampling in intertidal zones and on the neighbouring ocean floor would undoubtedly result in discovery of several species. The group is well represented along the Atlantic Coast of the United States (Newell 1947), and several species are known to occur in Nova Scotia.

Superfamily Tarsocheyloidea.

Members of the only family, Tarsocheylidae, are probably free-living predators found in moss, soil, and decaying wood habitats. Specimens of *Hoplocheylus atomarius* Berlese and *Tarsocheylus paradoxus* Berlese have been collected throughout southeastern Canada, and probably occur in the Park.

Superfamily Pyemotoidea.

Adult females of Pyemotidae and Acarophenacidae are parasitoids of eggs and larvae of various insects associated with wood and other plant material including stored products. Representatives of both families probably occur in the Park. Probing of the skin by members of some species of *Pyemotes* can cause severe dermatitis on some people handling infested material such as stored grain or hay.

Superfamily Scutacaroidea (= Pygmephoroidea).

Mites of this group typically live in edaphic habitats, nests or galleries of insects (especially ants and subcortical beetles), or nests of mammals. Adult females have specialized phoretic associations with their insect and mammal hosts, but are characteristically fungivorous. Members of the families Pygmephoridae and Scutacaridae, and especially of several species of the genus *Scutacarus*, are very abundant in litter habitats throughout the Park.

Superfamily Tarsonemoidea.

Tarsonemidae occur in a wide variety of habitats. Those found thus far in the park are fungivorous mites of the genus *Tarsonemus*, common in litter, and phytophagous members of *Steneotarsonemus*, abundant on grasses and sedges. Tarsonemids of some other genera are associates of social and subsocial insects, such as bees and bark beetles respectively, and members of several species of these genera probably also occur in the Park.

Superfamily Cheyletoidea.

This group includes nearly all of the families of actinedid mites that are parasites of vertebrates. Members of the family Cheyletidae are the only free living mites in this group, being predators of other mites in a variety of habitats including nests of animals, on plant foliage, under tree bark, and in stored products. Parasitic cheyletoids comprise Cheyletiellidae (skin parasites of birds and mammals), Cloacaridae (cloacal parasites of turtles), Myobiidae (ectoparasites of rodents, bats, and insectivores), Harpyrhynchidae (subcutaneous parasites of birds), Syringophilidae (parasites of feather quills of birds), Psorergatidae (subdermal parasites of mammals), and Demodicidae (subcutaneous and follicular parasites of mammals). Although no cheyletoid mites have been collected in the Park thus far, members of all these families probably occur there. Every species of bird and mammal in the Park is expected to have one or more species of cheyletoid parasite. It is likely that each species of bird in the Park harbours at least one species of syringophilid parasite suggesting that specimens of 200-300 species of these mites could be collected using the specialized techniques required to remove them from hosts.

Superfamily Raphignathoidea.

Mites of the families Barbutiidae, Raphignathidae, Caligonellidae, and Eupalopsellidae, and most Stigmaeidae, are predators in soil, litter, and moss habitats. Specimens of the barbutiid *Barbutia anguineus* (Berlese), the caligonellid *Molothrognathus leptostylus* Summers and Schlinger, and the stigmaeids *Stigmaeus sphagneti* (Hull), *S. eutrichus* Berlese, *S. glypticus* Summers, and *Mediolata acus* (Summers) are common examples of predaceous raphignathoid mites found in litter habitats in the Park. Specimens of *Raphignathus* spp., *Neognathus terrestris* (Summers and Schlinger), and *Eupalopsellus trudis* Summers, as well as of several other genera of predaceous Stigmaeidae, have been collected in eastern Canada, and members of these taxa may also occur in the Park. Stigmaeids of the genus *Eustigmaeus*, and Cryptognathidae, are unusual among Raphignathoidea in that they feed on mosses and possibly other lower plants. Members of *Eustigmaeus rotunda* (Wood), *E. acidophila* (Wood), *E. arctica* (Wood) and *E. microsegnis* (Chaudhri), along with those of *Cryptognathus corrugis* Summers and Chaudhri, are among the common phytophagous raphignathoids in the Park. Although no specimens of aquatic Homocaligidae have been collected in the Park, members of *Homocaligus muscorum* Habeeb are common in New Brunswick, and may well occur there.

Superfamily Tetranychoidea.

Many species of phytophagous spider mites (Tetranychidae) and false spider mites (Tenuipalpidae) occur on a wide variety of host plants in eastern Canada, and members of several of these species probably live in the Park. However, collections to date have yielded specimens of only one species. The virtual absence of tetranychoid mites from the more than 70 samples from rinsed foliage collected during July probably reflects the drastic natural decline in populations of active instars of these mites that takes place in mid-summer, rather than actual limitation of their distributions. Careful collecting on foliage and on herbaceous hosts in May and June, especially after a period of dry weather, would give a better indication of the diversity of tetranychoid mites in the Park.

Superfamily Eriophyoidea.

These tiny, four-legged mites, including the rust, gall, and bud mites, constitute a large and strictly phytophagous group associated with a wide variety of host plants. Members of most species are highly host specific, and may form extremely dense populations causing characteristic injury both locally and generally to hosts through their feeding activities.

Family Phytoptidae. Members of *Nalepella halourga* Keifer attack the foliage of fir and spruce throughout eastern North America, and were collected in the Park on Balsam Fir, and both Black and White Spruce. Specimens of *Novophytoptus* occur commonly as vagrants on the leaves of sedges in the Holarctic Region, and those of an apparently undescribed species were found in the Park in large numbers on these hosts. Of particular interest, populations of *Sierraphytoptus alnivagrans* Keifer, a foliage vagrant mite previously reported only from alders in extreme western North America, were discovered on Speckled Alder in the Park. A similar apparently disjunct east-west distribution was reported for another phytoptid, *Trisetacus neoabietis* Smith (Smith 1984a), known only from foliage of Amabilis Fir in coastal British Columbia and Balsam Fir in the Cape Breton Highlands. Members of another species of this genus, *Trisetacus grosmanni* Keifer, occur across the temperate Nearctic Region in firs and spruces (Smith 1984c), and were collected in the Park on White Spruce. Phytoptids of several other widespread species, notably *Setoptus jonesi* Keifer and *Trisetacus ehmanni* Keifer on Jack Pine, *S. strobacus* Keifer and *T. alborum* Keifer on White Pine, and *Phytoptus avellanae* (Nalepa) on Hazel Nut, have not yet been collected in the Park but occur in adjacent regions of Atlantic Canada.

Family Eriophyidae. This family comprises the typically vermiform gall and erineum mites, and the usually fusiform rust mites. Among the common mites causing galls on the foliage of woody perennials in the Park are *Aceria ulmi* (Garman) on American Elm, *Aceria* sp. nr. *rudis* (Canestrini) on Yellow and White Birches, *Eriophyes padi* (Nalepa) on Choke and Black Cherries, *E. pyri* (Pagenstecher) on Mountain Ash and Apple, *E. laevis* (Nalepa) on Speckled Alder and White Birch, *Eriophyes* sp. on White Ash, and *Vasates aceriscrumena* (Riley) and *V. quadripedes* (Shimer) on Sugar and Red Maples respectively. The most frequently observed erinea are caused by members of *Acalitus fagerinea* Keifer on American Beech, *Aceria elongatus* (Hodgkiss) on Sugar Maple, *Aceria trinema* Keifer on Red Oak, *Aceria* sp. on Speckled Alder, *Aceria* sp. nr. *calaceris* Keifer on Mountain Maple and *Phyllocoptes didelphis* Keifer on Trembling Aspen. Specimens of many species of rust mites were collected in the Park. Among these, the following species are widespread in eastern temperate North America: *Acaricalus paralobus* Keifer on Speckled Alder and *A. rhodaspris* Keifer on Red Oak; *Aculodes* sp. nr. *dubius* (Nalepa) on grasses; *Aculus fockeui* (Nalepa) on Black Cherry, *A. grandidentatus* Keifer on Trembling Aspen, *A. megacrinis* Keifer on Yellow Birch and *A. schlectendali* (Nalepa) on Apple; *Anthocoptes loricatus* (Nalepa) on Hazel Nut, *A. speciosus* (Nalepa) on Mountain Ash and *A. transitionalis* (Hodgkiss) on Sugar and Mountain Maples; *Cecidophyes quercialbae* Keifer on Red Oak; *Epitrimerus abietis* Keifer on Balsam Fir, *E. pungiscus* Keifer on White Spruce and *E. virginiana* Keifer on Choke Cherry; *Notalox rubigator* Keifer on Sugar and Red Maples; *Tegonotus dentilobus* (Hodgkiss) on Sugar Maple, *T. celinae* (Keifer) on Striped Maple, *T. simus* (Keifer) on Speckled Alder and *T. uranomus* (Keifer) on White and Yellow Birches; and both *Tetra americana* Keifer and *T. nielseni* Keifer on American Elm. On the other hand, the specimens of *Keiferella piceae* Boczek and *Monochetus sulcatus* Nalepa collected in the Park, on Black Spruce and American Beech respectively, represent the first reports of members of those genera in the Nearctic Region.

Family Diptilomiopidae. The big-beaked eriophyoid mites are represented in the Park by members of the genera *Diptacus* and *Rhyncaphytoptus*. Specimens of *Diptacus sacramentae* (Keifer), a widespread mite on nearctic alders, were found commonly on Speckled Alder, while those of an undescribed species were collected on Apple. The most frequently collected members of *Rhyncaphytoptus* belonged to the common species *R. atlanticus* Keifer on American Elm, *R. rubrifoliae* Keifer on Red Oak, and *R. saccharini* Keifer on Sugar Maple.

Superfamily Anystoidea.

Anystidae, the whirligig mites, are moderately large, fast moving, predaceous mites found in soil, litter, and moss habitats, and on plants. Members of *Anystis baccharum* (Linnaeus) are common throughout the Park and can often be observed on plants that are heavily infested with phytophagous mites. Paratydeidae are small, elongate mites living in soil and moss habitats, and found in scattered localities across southern Canada. Members of one species, *Scolotydeus simplex* Delfinado and Baker, were collected from lichens and moss on a tree trunk in the Park.

Mites of the remaining 11 actinedid superfamilies, representing the Parasitengona, have a common life history pattern involving a larva that is ectoparasitic on a host animal, a quiescent protonymph (calyptostase I or nymphochrysalis), an active and usually predaceous deutonymph, a quiescent tritonymph (calyptostase II or imagochrysalis), and an active and usually predaceous adult.

Superfamily Calyptostomatoidea.

The large, slow moving, predaceous deutonymphs and adults of the genus *Calyptostoma* inhabit wet moss and litter, usually near bodies of water, throughout the world. The larvae are parasites of adult crane flies (Tipulidae). Members of one apparently highly variable species, *Calyptostoma velutina* (Muller), are found commonly in the Park.

Superfamily Erythraeoidea.

The large, active, usually orange or reddish-coloured deutonymphs and adults of Erythraeidae and Smarididae are common predators in soil, litter, and moss habitats, and in some cases, on plants. Larvae are parasites of a wide variety of arthropod hosts. In the Park, erythraeids such as *Abrolophus* sp., *Erythraeus* sp. and *Leptus* sp., and smaridids belonging to *Hirstiosoma* sp., are conspicuous elements of the litter fauna. Members of the erythraeid genus *Balaustium* are unusual in that larvae, as well as deutonymphs and adults, are predaceous, and numerous specimens of at least one species were collected both in litter and on plant foliage.

Superfamily Trombidioidea.

The active, predaceous postlarval instars of these large, usually reddish mites typically live in litter and moss habitats. Larvae of Trombidiidae (velvet mites) Trombellidae and Johnstonianidae are parasites of insects, while those of Trombiculidae (the infamous chigger mites) parasitize vertebrates. Members of several genera of trombidiids, the trombellid genus *Eothrombium*, and the johnstonianid genera *Charadacarus* and *Diplothrombium* occur throughout the Park and can readily be observed, especially on sheltered, mossy substrates. Adventitious chigger infestations on man are common in extreme southern Ontario and Quebec, but the species found in Cape Breton Highlands National Park do not appear to be significant pests of humans.

Superfamily Stygothrombidioidea.

The moderately large, vermiform deutonymphs and adults inhabit gravel deposits in the beds of streams and rivers (interstitial habitat). The larvae are parasites of adult stoneflies (Plecoptera). Members of one or more species occur commonly in the Park.

The following seven superfamilies comprise the water mites, or Hydrachnida. Deutonymphs and adults of these mites live in all types of fresh water habitats throughout the world (Cook 1974), while larvae are parasites of adult insects (Smith and Oliver 1976, 1986).

Superfamily Hydrovolzioidea.

Family Hydrovolziidae. The heavily sclerotized, slow moving deutonymphs and adults cling to moss and detritus in cold springs and seepage areas with water temperatures below 10°C. Larvae of *Hydrovolzia* are known to be parasites of mesoveliid bugs and empidid flies. Members of *Hydrovolzia mitchelli* Habeeb are common throughout the Atlantic Provinces, and specimens were collected in the Park from springs near McIntosh Brook, at the Grande Anse Picnic Area, and beside the Corney Brook, Fishing Cove, and Aspy Trails.

Superfamily Eylaoidea.

These large, soft-bodied, reddish mites are found in a wide variety of aquatic habitats.

Family Eylaidae. Deutonymphs and adults of *Eylais* can readily be observed swimming about rapidly in shallow ponds and temporary pools during early Spring, and recognized by their habit of dragging the hind legs behind the body while swimming. Although no specimens have been collected in the Park as yet, members of several species occur commonly throughout the Atlantic Provinces, including Cape Breton Island, and probably can be found in the Park during April and May. Larvae of these mites are parasites of aquatic bugs (Hemiptera) and beetles (Coleoptera). In many species of *Eylais* adapted to exploit vernal temporary pools, the larvae undergo arrested development while attached to the host from June until the following Spring. During this period, when the pools are dry, the hosts migrate to permanent water habitats but the mite larvae do not complete engorgement and transform to deutonymphs until the hosts return to the vernal habitats as the latter fill with melt water (Wiggins *et al.* 1980).

Family Limnocharidae. Deutonymphs and adults of *Limnochares* live in ponds, shallow lakes, and pools in streams. Specimens of *L. americana* Lundblad were collected in the Park from pools in a stream beside the road to Mary Ann Falls, and members of this species and *L. aquatica* (Linnaeus) occur commonly in the Atlantic Provinces and throughout eastern Canada. Larvae of *L. americana* parasitize adult dragonflies (Odonata) while those of *L. aquatica* utilize water striders (Gerridae) as hosts. Deutonymphs and adults of *Neolimnochares* typically inhabit pools in streams. Specimens of a new species that is widespread in eastern Canada were collected in a woodland pool in a flood channel of the Cheticamp River at La Prairie. Larvae of this species apparently also parasitize water striders. Although no specimens of *Rhyncolimnochares* have yet been found in the Park, adults of *R. kittatinniana* Habeeb have been collected from gravel deposits in the South West Margaree River, and probably occur in some of the rivers of the Park.

Family Piersigiidae. Deutonymphs and adults of *Piersigia* crawl about in dense vegetation and detritus in seepage areas, temporary pools, and marshes. No specimens have yet been collected in the Park, but members of *P. americana* Habeeb are distributed widely throughout eastern Canada. Larvae are parasites of adult water scavenger beetles (Hydrophilidae).

Superfamily Hydrachnoidea.

Family Hydrachnidae. Deutonymphs and adults of *Hydrachna* (the only genus in the superfamily) are large, spherical, reddish mites that typically are well sclerotized. Members of most species inhabit temporary pools, and have larval host associations and life histories similar to those of *Eylais*, though the two groups do not appear to be closely related (Wiggins *et al.* 1980). No specimens have been collected in the Park, but large numbers can probably be found there in early Spring. Members of several species occur commonly throughout eastern Canada, including the Atlantic Provinces.

Superfamily Hydryphantoidea.

Family Hydryphantidae. Deutonymphs and adults of these moderately large, reddish mites occur in a very wide range of habitats. Members of several species of Thyadinae are common inhabitants of cold water seepage areas and spring runs in eastern Canada and specimens of many of these species were collected in the Park. Larvae are parasites of various nematocerous flies (Diptera) (Smith and Oliver 1976, 1986). There are large populations of *Panisopsis gorhami* (Habeeb) in the cold springs along McIntosh Brook; members of *Panisus condensatus* Habeeb occur in small streams near Warren Lake, near Neils Harbour, and on French Mountain, while those of *P. cataphractus* (Koenike) inhabit seepage areas near Pleasant Bay; specimens of *Thyas rivalis* Koenike and *Thyopsis cancellata* Protz were collected in seepage areas near Pleasant Bay and on French Mountain; several individuals of *Euthyas mitchelli* Cook were found in pools in small streams near Warren Lake, on French Mountain and beside the Aspy Trail above Beulach Ban Falls. Members of other thyadine species that inhabit vernal temporary pools, such as *Euthyas truncata* (Neuman), *Thyas barbigera* Viets, *T. stolli* (Koenike), *T. inepta* Lundblad, *Thyasides sphagnorum* Habeeb, and *Zschokkea bruzelii* (Lundblad), occur commonly throughout eastern North America and probably can be found in the Park during early Spring. Protziinae inhabit riffle areas of streams and rivers, and members of *Protzia eximia* Protz occur throughout eastern Canada and are abundant in the Park. The larvae parasitize nematocerous flies (Diptera) and caddisflies (Trichoptera). The subfamily Wandesiinae is represented in eastern Canada by vermiform mites of the genus *Wandesia*, inhabitants of the interstitial regions of gravel deposits in streams. Specimens of at least one species (probably *W. gaspensis* Habeeb) are common in the Park. Larvae are parasites of adult stoneflies (Plecoptera). Members of *Pseudohydryphantes orbicularis* Marshall, the only species of Pseudohydryphantinae known from eastern Canada, were not collected in the Park during this study, but are widespread in lakes and pools in the Atlantic Region and were collected in Lake O'Law just south of the Park.

Family Hydrodromidae. Deutonymphs and adults of *Hydrodroma* are moderately large, orange mites that inhabit lakes, ponds and streams. Larvae parasitize nematocerous Diptera (Smith and Oliver 1976, 1986). Members of *Hydrodroma despiciens* (Muller) are very abundant in lakes and ponds in eastern Canada, and those of at least one undescribed species live in streams. Specimens of both of these forms were collected in the Park.

Members of *H. despiciens* are unusual among water mites in being able to survive and complete their life history in acid bog lakes, and represent the only species of water mite in most of these habitats in the Park.

Family Rhynchohydracaridae. Deutonymphs and adults of *Clathrosperchon* crawl about on debris in riffle areas of streams. Larvae are unknown. Although none of these mites has been collected in the Park as yet, members of *Clathrosperchon americana* Habeeb occur in southern New Brunswick and Nova Scotia, and may ultimately be found in the Park.

Superfamily Lebertioidea.

Family Anisitsiellidae. Deutonymphs and adults of *Bandakia*, the only genus reported from eastern Canada, are small, well-sclerotized mites that crawl about in vegetation and detritus in seepage areas or riffle areas of streams (Smith 1979). The larvae parasitize adult tanypodine midges (Chironomidae) (Smith 1979, 1982). Members of *Bandakia borealis* Smith and *B. similis* Cook are common in seepage areas throughout the Park, while specimens of *B. phreatica* Cook have been collected in many of the streams at lower elevations.

Family Lebertiidae. Deutonymphs and adults of *Lebertia* are small to moderately large, usually soft bodied mites that are nearly ubiquitous in flowing water habitats throughout North America. The larvae are parasites of a wide variety of adult chironomid midges (Chironomidae) (Smith 1982). There are many species of *Lebertia* in eastern North America, and the taxonomy of the genus needs to be thoroughly revised. Specimens collected thus far, in seepage areas, streams, and rivers in the Park appear to represent at least 10 species.

Family Oxidae. Deutonymphs and adults of the two genera that occur in eastern North America are small, often well-sclerotized mites that swim about in lakes, ponds, and pools in streams. Larvae parasitize adult chironomid midges (Smith 1982). Members of *Oxus (Gnaphiscus) setosus* (Koenike) are abundant in pools in the Grande Anse River and its tributaries near Pleasant Bay, and specimens of *Frontipoda americana* Marshall were collected in French Lake, and in pools near the Cheticamp River at La Prairie.

Family Rutripalpidae. Adults of *Rutripalpus* are small, soft-bodied mites that previously had been reported only from a seepage area near Leningrad, U.S.S.R. While no specimens of this genus were found in the Park, a population of an apparently new species was discovered on Cape Breton Island near Skye Glen.

Family Sperchonidae. Deutonymphs and adults of *Sperchon* and *Sperchonopsis* are moderately large, soft-bodied or well-sclerotized mites inhabiting seepage areas and riffle zones in streams and rivers. The larvae utilize adult chironomid midges or black flies (Simuliidae) as hosts (Smith 1982). As in the case of *Lebertia*, the taxonomy of mites of the genus *Sperchon* in North America requires extensive revision. About 10 of the many species known from eastern Canada are represented among the specimens collected in the Park. No specimens of *Sperchonopsis* have been found in the Park as yet, but members of one species occur in nearby areas of Nova Scotia and New Brunswick.

Family Teutoniidae. The moderately large, soft-bodied deutonymphs and adults of *Teutonia* swim rapidly in pools in streams and limnocrene springs. Larvae parasitize adult chironomid midges (Smith 1982). Members of *Teutonia (Subteutonia) setifera* Habeeb are common in these habitats throughout the Park. Specimens of a second species, *T. (s.s.) lundbladi* Habeeb, occur in the Atlantic Provinces, but have not yet been collected in the Park.

Family Torrenticolidae. Deutonymphs and adults of *Torrenticola* and *Testudacarus* are moderately large, heavily sclerotized mites that crawl about on stones and debris, typically in riffle areas of streams. The larvae are parasites of adult chironomid midges (Smith 1982). Members of at least 5 species of *Torrenticola*, and of *Testudacarus vulgaris* Habeeb, have been collected in the Park.

Superfamily Hygrobatoidea.

Family Limnesiidae. Deutonymphs and adults of *Limnesia* are moderately large, typically soft-bodied mites that swim about in lakes, ponds, and pools in streams. Larvae parasitize adult chironomid midges (Smith and Oliver 1976, 1986). Although members of many species of this genus are common in eutrophic aquatic habitats throughout eastern Canada, those of only four species have been found in the Park. Specimens of *Limnesia undulata* (Müller) and *L. connata* Koenike were collected in pools near the Cheticamp River at La Prairie, those of *L. cornuta* Wolcott are common both in these pools and in Warren Lake, and individuals of *L. coerulea* Lundblad were collected in French Lake and a boggy pool near the lake. Deutonymphs and adults of *Tyrrellia* crawl about on wet detritus in seepage areas and around the edges of lakes, ponds, and streams. The larvae are parasites of adult no-see-ums (Ceratopogonidae). While no specimens of this genus have been collected in the Park, members of *T. ovalis* Marshall occur in localities throughout the Atlantic Provinces, and probably can be found there.

Family Aturidae. Deutonymphs and adults of Albiinae are moderately large, heavily sclerotized mites that swim about in lakes or pools in streams. Larvae parasitize adult caddisflies (Trichoptera) (Smith 1984b). No specimens have been found as yet in the Park, but members of *Albia caerulea* Marshall are common inhabitants of lakes in southern Nova Scotia. The small, sclerotized deutonymphs and adults of Aturinae crawl around on moss, detritus, and stones in seepage areas, or in riffle zones and gravel bars in streams. The larvae are parasites of adult chironomid midges (Smith 1977b, 1984b). Members of *Kongsbergia semiornata* Habeeb, common throughout eastern North America, were collected in riffles in small streams crossing the road to Mary Ann Falls and crossing the Cabot Trail near Neils Harbour, Still Brook, MacKenzie River, Cheticamp River, Fishing Cove River and North Aspy River. Specimens representing at least 10 species of *Aturus* were found in the

Park. Members of some species such as *Aturus droueti* Habeeb and *A. howellae* Habeeb occur in small, cold streams, while those of others such as *A. estellae* Habeeb were found only in larger streams and rivers. Populations of several species including *A. acadiensis* Habeeb, *A. canadensis* Habeeb, *A. deceptor* Habeeb, and *A. mirabilis* Piersig thrive in both of these habitat types in the Park. Like Aturinae, deutonymphs and adults of Axonopsinae are small and well sclerotized, but they are more diverse morphologically and exploit a wider variety of habitats. The larvae also parasitize adult chironomid midges (Smith 1977b, 1984b). Members of the closely related species *Brachypoda setosicauda* Habeeb and *B. acuticauda* Habeeb live in riffles and pools in all of the larger streams and rivers in the Park, while those of *B. cornipes* Habeeb were found in woodland pools in a flood channel of the Cheticamp River at La Prairie. Specimens of an undescribed species of *Diamphidaxona*, similar to those of *D. pallida* Cook from the southern Appalachian and Ozark regions (Cook 1963c), were found in gravel deposits in the North Branch of the North Aspy River and Clyburn Brook. These are the first individuals of this genus to be found in Canada. A small population of *Estellacarus unguitarsus* (Habeeb), a mite previously collected in eastern North America only in Victoria County, New Brunswick, was found in woodland pools in a flood channel of the Cheticamp River at La Prairie. Members of *Ljania bipapillata* Thor and *Woolastookia pilositarsa* (Habeeb) live in riffles in flowing water throughout temperate eastern North America, and were collected in many of the streams and rivers in the Park. Although no specimens of the genus *Axonopsis* have been collected in the Park as yet, those of at least three species are known to live in streams and lakes in southern Nova Scotia and New Brunswick, and some may occur on Cape Breton Island.

Family Feltriidae. The tiny, reddish coloured deutonymphs and adults crawl about on vegetation, stones, and detritus in seepage areas and riffles in streams. Larvae utilize adult chironomid midges as hosts (Smith and Oliver 1976, 1986). Specimens of the holarctic species *Feltria minuta* Koenike were collected in Clyburn Brook, as well as in several rivers just outside the Park. Members of *F. amoenella* Habeeb, a boreal nearctic species, were found in many brooks and rivers in the Park, and those of *F. faceta* Cook, a species with an Appalachian-Ozark distribution, were collected in Clyburn Brook and in a small stream crossing the road to Mary Ann Falls. Members of the other three species live in spring habitats in the Park; those of *Feltria plana* Cook in a seepage area near Cap Rouge, and those of two possibly new species, similar to *F. cornuta* Walter and *F. cataphracta* Cook, in a spring run near Warren Lake.

Family Hygrobatidae. Deutonymphs and adults of *Atractides* and *Hygrobates* are moderately large, soft-bodied or partially sclerotized mites that live in a wide variety of habitats. Larvae have been recorded as parasites of adult chironomid midges of many genera (Smith and Oliver 1976, 1986). Members of several species of each of these hygrobatid genera are common in pools and streams throughout the Park, but they cannot be named with confidence until revisionary work is completed on these taxa.

Family Pionidae. Deutonymphs and adults are moderately large, typically soft-bodied mites that live in a remarkably wide range of habitats. Larvae parasitize adult chironomid midges (Smith 1976). Foreliini are represented in the Park by species of *Forelia* and *Pseudofeltria*. A few specimens of *Forelia americana* Cook, a common species throughout temperate North America, were collected in pools in a flood channel of the Cheticamp River at La Prairie. Members of the nearctic species *Pseudofeltria multipora* Cook occur in many seepage areas and springs in the Park. Specimens of *Pionacercus leuckarti* (Piersig) were reportedly collected in pools in New Brunswick (Habeeb 1955), but this remains the only record of the genus from eastern North America. The only representatives of Hydrochoreutini known from the Park are female specimens of a species of *Hydrochoreutes* collected in pools in a flood channel of the Cheticamp River at La Prairie. Members of two species of Huitfeldtiini, *Neotiphys pionoidellus* (Habeeb), widespread in the eastern Nearctic, and *Pionopsis fragilis* Habeeb, known only from the Maritime Provinces, were found commonly in pools associated with streams in the Park. Although no specimens of the genus *Tiphys* have been discovered in the Park, members of several species live in vernal temporary pools throughout eastern North America (Smith 1976, Wiggins *et al.* 1980), and probably can be collected in the Cape Breton Highlands during April and May. Representatives of two genera of Pionini occur in the Park. Members of *Nautarachna muskoka* Smith live in pools in several of the streams, while those of *N. queticoensis* Smith inhabit seepage areas and riffles in the smaller brooks. Both of these species have wide distributions in eastern Canada (Smith 1972, 1976). Specimens of at least five species of the *Piona* rotunda complex were found, with the greatest diversity in the pools in a flood channel of the Cheticamp River at La Prairie. Members of one undescribed species similar to *Piona debilis* (Wolcott) inhabit upland lakes such as French Lake and Benjies Lake. Representatives of several species of the *Piona* nodata complex live in vernal temporary pools throughout eastern North America (Smith 1976, Wiggins *et al.* 1980), and probably can be found in the Park during early Spring.

Family Unionicolidae. The moderately large, soft-bodied to well-sclerotized deutonymphs and adults inhabit ponds and lakes. Those of many species of *Unionicola* live as parasites in the mantle cavity of fresh water mussels. Larvae are parasites of adult chironomid midges of the tribe Chironomini (Smith and Oliver 1976, 1986). Members of two genera occur in the Park. Specimens of two species of *Neumania* and two free-living species of the *Unionicola* crassipes complex were collected in pools in a flood channel of the Cheticamp River at La Prairie. No specimens of *Koenikea* were found in the Park, but members of one species of this genus occur in lakes in southern Nova Scotia and may yet be discovered in the Cape Breton Highlands.

Superfamily Arrenuroidea.

Deutonymphs and adults are small to large, typically heavily sclerotized mites with representatives in virtually all types of freshwater habitats. Larvae are parasites of adults of a variety of nematocerous flies (Diptera), caddisflies (Trichoptera), and dragon and damselflies (Odonata) (Smith 1978, Smith and Oliver 1976, 1986).

Family Acalyptonotidae. A single specimen of *Paenacalyptonotus fontinalis* Smith, the first from Nova Scotia, was found in a seepage area near Pleasant Bay. This species was previously known from similar habitats in Ontario, New Brunswick, and Newfoundland.

Family Arrenuridae. Members of over 75 species of *Arrenurus* are among the most abundant water mites, especially in eutrophic lentic habitats, in eastern North America. The extremely limited diversity of species of *Arrenurus* in the Park reflects the virtual absence of this type of habitat in the Cape Breton Highlands. Members of *Arrenurus (Megaluracarus) mamillanus* Marshall are widely distributed in eastern Canada, and were commonly found in pools associated with seepage areas and small streams in the Park. Several specimens of *A. (M.) siegasianus* Habeeb, a common eastern Nearctic species, were collected in pools at La Prairie and near Pleasant Bay, and a single individual of the rare *A. (M.) solifer* Marshall was taken in a seepage pool near Pleasant Bay. The larvae of these species probably are parasites of tanypodine chironomid midges.

Family Athienemanniidae. Members of *Chelomideopsis besselingi* (Cook), the only species of this family known from eastern North America, are common in seepage areas and spring runs throughout eastern Canada, and many specimens were collected in the Park. The larvae parasitize chironomid midges (Smith 1978).

Family Chappuisididae. Many specimens of *Chappuisides* sp.nr. *eremitus* Cook, the only recognized species of this family in North America (Cook 1963a, 1974), were collected in gravel deposits in the Grande Anse River, Fishing Cove River, McIntosh Brook, Warren Brook, and in spring runs feeding Corney Brook, Canadian Brook, and Warren Lake. The distribution of the mites assigned to this species is puzzling, including the hills of Nova Scotia, New Brunswick, Newfoundland, the Gaspé region of Québec, and New Hampshire in the east, and Wyoming and California in the west. No populations have been discovered between New Hampshire and Wyoming, and it is quite possible that when careful morphological comparisons are made the eastern populations will be recognized as a new species. Larvae are unknown.

Family Laversiidae. Members of the only species of this family, *Laversia berulophila* Cook, inhabit cold (less than 10°C) springs and seepage areas throughout temperate North America. Specimens were collected in two spring habitats in the Park near Pleasant Bay. The larvae are parasites of chironomid midges (Smith 1978).

Family Mideopsidae. Mites of the genus *Nudomideopsis* live in seepage areas and in gravel deposits in spring-fed streams. Members of *Nudomideopsis magnacetabula* (Smith), the only known nearctic species, are widespread in eastern Canada (Smith 1977a, 1983b). Specimens were collected in the Park in seepage areas at Cap Rouge and beside the Aspy trail above Beulach Ban Falls, and in the Grande Anse River, Canadian Brook and a spring-fed tributary of Corney Brook. Specimens of seven species of *Mideopsis* were collected in the Park, two belonging to the subgenus

Mideopsis and five to the subgenus *Xystonotus*. Members of *Mideopsis* (*s.s.*) are active swimmers in lentic habitats, and the two species represented in the Park were uncommon. Several specimens of *Mideopsis crassipes* Soar, a boreal holarctic species, were found in pools in a flood channel of the Cheticamp River, and one specimen of the most widespread nearctic species, *M. borealis* Habeeb, was found in a pool in the Grande Anse River. Mites of the subgenus *Xystonotus* crawl about in mosses in seepage areas and in gravel deposits in streams. Members of *M. (X.) delicata* (Habeeb) occur in streams throughout temperate eastern North America, and were collected in several of the brooks in the Park. Members of *M. (X.) wolcotti* Cook, an uncommon but widespread eastern nearctic species, were found in a seepage area beside a small stream on French Mountain. Specimens of two species known only from Atlantic Canada and northern New England, *M. (X.) paramecia* Cook and a new species similar to *M. (X.) delicata*, were very common in most of the larger and smaller streams respectively. Populations of another new species were found in a small stream near Warren Lake and in Trout Brook. These mites are particularly interesting as they appear to represent the sister species of *M. (X.) pumila* Cook, a species restricted to western North America. Larvae of Mideopsidae parasitize adult chironomid midges (Smith 1978).

Family Monioniidae. Members of the genus *Stygomomonia* inhabit gravel deposits in streams, and members of at least one species, *S. riparia* Habeeb, were collected commonly in most of the brooks in the Park. Although no specimens of *Momonia* have been found in the Park as yet, members of the eastern nearctic *M. marciae* Habeeb occur quite commonly in pools and lakes in southern Nova Scotia, and may also be discovered on Cape Breton Island. Larval Momoniidae are parasites of adult caddisflies (Trichoptera) (Smith 1978).

Family Neoacaridae. Mites of the genera *Neoacarus* and *Volsellacarus* typically inhabit gravel deposits in streams. One specimen of *Neoacarus similis* Cook, a species with an Appalachian-Ozark distribution except for a reported population in Wyoming (Cook 1963b), was collected in the Cheticamp River. Members of this species occur commonly in rivers in southern Atlantic Canada. Several specimens of a probable new species of *Volsellacarus* (near *V. sabulonus* Cook) were collected in the Park, from Clyburn Brook, Corney Brook, and the North Aspy and Fishing Cove Rivers, and from several other streams in northern Cape Breton. Members of *V. sabulonus* were previously reported from Ohio and New York (Cook 1968), and specimens of the new species have been found in southern New Brunswick. Larvae of Neoacaridae parasitize adult chironomid midges (Smith 1983a).

Family Uchidastygacaridae. Members of *Uchidastygacarus acadiensis* Smith live in gravel deposits in cool streams throughout Atlantic Canada and northern New England (Smith 1983c), and were collected in the Grande Anse River, MacIntosh Brook, and a small stream near Warren Lake in the Park. These mites represent the sister species of *U. imamurai* Cook, found in Montana and Oregon.

Table 6. Census of Actinedida known or expected to occur in Cape Breton Highlands National Park (** known from Cape Breton Island and * known from Atlantic Provinces)

Cohort & Superfamily	Family	Genera known from Canada	No. species known from eastern Canada	No. species known from Cape Breton Highlands National Park
Endeostigmata				
Pachygnathoidea	Alicorhagiidae	*Alicorhagia*	1	1
	Lordalycidae	*Lordalycus*	1	1
	Nanorchestidae	*Nanorchestes*	3	1
		Speleorchestes	2	1
	Bimichaelidae	*Alycus*	2	2
		Bimichaelia	3	3
		Pachygnathus	1	0
	Terpnacaridae	*Terpnacarus*	1*	0
Nematalycoidea	Nematalycidae	*Micropsammus*	0	0
Eupodina				
Eupodoidea	Eupodidae	*Benoinyssus*	1	1
		Claveupodes	1	1
		Cocceupodes	5	3
		Eupodes	2	1
		Linopodes	3	2
		Protereunetes	2	1
	Penthaleidae	*Penthaleus*	2	0
	Penthalodidae	*Penthalodes*	1	1
		undescribed genus	1	1
	Rhagidiidae	*Bervipalpia*	1	0
		Coccorhagidia	8	4
		Evadorhagidia	1	0
		Foveacheles	1	0
		Hammenia	1	0
		Krantzia	0	0
		Parallelorhagidia	1	0
		Poecilophysis	3	0
		Rhagidia	11	5
		Robustocheles	1	0
		Shibaia	1	1
		Thoria	1	0
		undescribed genera	2	0
	Strandtmanniidae	*undescribed*		
Tydeoidea		*genus*	1	1
	Ereynetidae	*Ereynetes*	5	2
		Ereynetoides	0	0
		Riccardoella	1	0

		Tydeidae	*Afrotydeus*	1	1
			Coccotydaeolus	1*	0
			Eotydeus	1	1
			Homeopronematus	0	0
			Lasiotydeus	0	0
			Meyerella	0	0
			Metatydaeolus	1	0
			Microtydeus	2	1
			Paralorryia	3	1
			Paratriophtydeus	1	1
			Pretydeus	2	1
			Pronematus	2	0
			Triophtydeus	5	2
			Tydaeolus	1	1
			Tydeus	10	5
	Bdelloidea	Bdellidae	*Bdella*	5	2
			Bdellodes	5	2
			Biscirus	1*	0
			Cyta	1	1
			Neomolgus	1	1
			Spinibdella	2*	0
			Trachymolgus	1	0
		Cunaxidae	*Armascirus*	1	1
			Bonzia	2	2
			Cunaxa	1	1
			Cunaxoides	2	1
			Neocunaxoides	1*	0
			Pseudobonzia	2	2
			Scirula	1*	0
	Halacaroidea	Halacaridae	*Copidognathus*	1*	0
			Lohmanella	1*	0
			Porohalacarus	1	0
			Porolohmanella	1	0
			Rhombognathus	1*	0
			Soldanellonyx	1**	0
			Thalassarachna	5**	0
			Walterella	1*	0
Labidostommatina					
	Nicoletielloidea	Nicoletiellidae	*Labidostomma*	0	0
Eleutherengona					
	Tarsocheyloidea	Tarsocheylidae	*Hoplocheylus*	1*	0
			Tarsocheylus	1*	0
	Heterocheyloidea	Heterocheylidae	*Heterocheylus*	1	0
	Pyemotoidea	Acarophenacidae	*Paracarophenax*	0	0
		Caraboacaridae	*Caraboacarus*	1	0
		Dolichocybidae	*Pavania*	1	0
		Pyemotidae	*Pyemotes*	1*	0
		Trochometridiidae	*Trochometridium*	0	0
	Scutacaroidea (=Pygmephoroidea)	Microdispidae	*Brennandania*	1	1
			Microdispodides	1	0
			Premicrodispus	1	0

	Pygmephoridae	*Acinogaster*	1	1
		Bakerdania	15	2
		Ellatoma	0	0
		Pediculaster	1*	0
		Pygmephorus	1	0
		Siteroptes	2	2
		Xystorostrum	1	1
	Scutacaridae	*Imparipes*	10	2
		Pygmodispus	1	1
		Scutacarus	25	12
Tarsonemoidea	Podapolipidae	*Eutarsopolipus*	1	0
	Tarsonemidae	*Acarapis*	2	0
		Acaronemus	0	0
		Daidalotarsonemus	1	0
		Dendroptus	5	0
		Heterotarsonemus	1	0
		Iponemus	7	0
		Phytonemus	1	0
		Polyphagotarsonemus	1	0
		Pseudotarsonemoides	1	0
		Rhynchotarsonemus	0	0
		Steneotarsonemus	8	1
		Tarsonemus	30	2
		Xenotarsonemus	1	0
Raphignathina				
Cheyletoidea	Cheyletidae	*Cheyletia*	1	0
		Cheyletogenes	1*	0
		Cheyletomimus	1	0
		Cheyletus	1*	0
		Eucheyletia	1*	0
		Hemicheyletia	0	0
		Neoacaropsis	1	0
		Neochelacheles	1	0
		Neoeucheyla	2*	0
		Paracheyletia	1*	0
	Cheyletiellidae	*Bakericheyla*	0	0
		Cheyletiella	2	0
		Ornithocheyletia	1	0
	Cloacaridae		0	0
	Demodicidae	*Demodex*	1*	0
	Harpyrhynchidae	*Harpyrhynchus*	0	0
	Myobiidae	*Myobia*	2*	0
		Protomyobia	1	0
		Radfordia	1*	0
	Psorergatidae	*Psorergates*	3	0
		Psorobia	1	0
	Syringophilidae	*Syringophilopsis*	1	0
Raphignathoidea	Barbutiidae	*Barbutia*	1	1
	Caligonellidae	*Caligonella*	1	0
		Molothrognathus	1	1
		Neognathus	1*	0

	Camerobiidae	*Camerobia*	0	0
	Cryptognathidae	*Cryptognathus*	3	1
	Eupalopsellidae	*Eupalopsellus*	1*	0
	Homocaligidae	*Homocaligus*	1*	0
	Xenocaligonellidae	*Dasythraeus*	1	0
	Raphignathidae	*Raphignathus*	3	0
	Stigmaeidae	*Cheylostigmaeus*	3	1
		Eustigmaeus	20	9
		Ledermuelleriopsis	1*	0
		Mediolata	1	1
		Stigmaeus	10	5
		Villersia	1	0
		Villersiella	1	1
		Zetzellia	1*	0
Tetranychoidea	Tetranychidae	*Bryobia*	2	1
		Eotetranychus	10*	0
		Eurytetranychus	1	0
		Eutetranychus	1	0
		Lindquistiella	1*	0
		Monoceronychus	1	0
		Neopetrobia	0	0
		Oligonychus	8*	0
		Panonychus	1*	0
		Petrobia	2*	0
		Schizotetranychus	1	0
		Tetranychus	5*	0
	Tenuipalpidae	*Aegyptobia*	0	0
		Brevipalpus	1	0
		Dolichotetranychus	0	0
		Pentamerismus	2*	0
		Tenuipalpus	1	0
	Linotetranidae	*Linotetranus*	0	0
Eriophyoidea	Phytoptidae	*Nalepella*	4	1
		Novophytoptus	1	1
		Phantacarus	0	0
		Phytoptus	3*	0
		Setoptus	2*	0
		Sierraphytoptus	1	1
		Trisetacus	11	2
	Eriophyidae	*Abacarus*	1*	0
		Acalitus	3	1
		Acaphylla	1	1
		Acaphyllisa	1*	0
		Acaricalus	3	3
		Aceria	20	7
		Aculodes	1	1
		Aculops	5	1
		Aculus	15	7
		Anthocoptes	5	3
		Calepitrimerus	4*	0
		Caliphytoptus	0	0

			Cecidophyes	5	1
			Cecidophyopsis	3*	0
			Cenalox	1	0
			Colomerus	1	0
			Cupacarus	0	0
			Epitrimerus	10	5
			Eriophyes	10	5
			Kieferella	1	1
			Monochetus	1	1
			Phyllocoptes	12	4
			Phyllocoptruta	1	1
			Platyphytoptus	2*	0
			Tegolophus	1	0
			Tegonotus	10	4
			Tetra	2	2
			Tetraspinus	1	1
			Vasates	3	2
		Diptilomiopidae	*Apodiptacus*	1	0
			Asetacus	0	0
			Diptacus	3	2
			Peralox	1	0
			Rhyncaphytoptus	5	3
Anystina					
	Anystoidea	Adamystidae	*Adamystis*	0	0
		Anystidae	*Anystis*	1	1
			Chausseria	0	0
			Erythracarus	0	0
			Tarsotomus	0	0
			Tencateia	0	0
		Pseudocheylidae	*Anoplocheylus*	1	0
	Caeculoidea	Caeculidae	*undetermined*	0	0
	Paratydeoidea	Paratydeidae	*Scolotydeus*	1	1
	Pomerantzioidea	Pomerantziidae	*Pomerantzia*	1	0
Parasitengona					
	Calyptostomatoidea	Calyptostomatidae	*Calyptostoma*	1	1
	Erythraeoidea	Erythraeidae	*Abrolophus*	2	1
			Augustsonella	0	0
			Balaustium	2	1
			Callidosoma	1	0
			Charletonia	1	0
			Erythraeus	2	1
			Leptus	5	1
			Paraphanolophus	1	0
		Smarididae	*Hirstiosoma*	1	1
			"Phanolophus"	1*	0
	Trombidioidea	Johnstonianidae	*Centrotrombidium*	1*	0
			Charadacarus	1	1
			Diplothrombium	1*	0
		Trombellidae	*Eothrombium*	1	1
		Trombidiidae	*Allothrombium*	2	1
			Aphithrombium	1	1
			Camerotrombidium	1*	0

		Eutrombidium	1*	0
		Megophthrombium	0	0
		Microtrombidium	5	2
		Paratrombium	2	1
		Podothrombium	1	1
		Trichotrombidium	1	1
		Trombidium	2*	0
		Valgothrombium	1	1
	Trombiculidae	*Euschoengastia*	1*	0
		Leptotrombidium	1	0
		Neotrombicula	2	1
		Trombicula	2*	0
Stygothrombi-dioidea	Stygothrombidiidae	*(Hydrothrombium)*	10	2
Hydrovolzioidea	Hydrovolziidae	*Hydrovolzia*	2	1
Eylaoidea	Eylaidae	*Eylais*	20**	0
	Limnocharidae	*Limnochares*	2	1
		Neolimnochares	1	1
		Rhyncolimnochares	1**	0
	Piersigiidae	*Piersigia*	2*	0
Hydrachnoidea	Hydrachnidae	*Hydrachna*	20**	0
Hydryphantoidea	Hydryphantidae	*Cowichania*	0	0
		Euthyas	2	1
		Hydryphantes	3**	0
		Panisopsis	3	1
		Panisus	2	2
		Partnunia	0	0
		Protzia	2	1
		Pseudohydryphantes	1**	0
		Tartarothyas	1	0
		Thyas	4	1
		Thyasella	0	0
		Thyasides	1*	0
		Thyopsella	1*	0
		Thyopsis	1	1
		Trichothyas	1	0
		Wandesia	2	1
		Zschokkea	1*	0
	Hydrodromidae	*Hydrodroma*	2	2
	Rhynchohydracharidae	*Clathrosperchon*	1*	0
Lebertioidea	Anisitsiellidae	*Bandakia*	5	3
		Bandakiopsis	0	0
		Cookacarus	0	0
		Utaxatax	0	0
	Lebertiidae	*Lebertia*	20+	10+
	Oxidae	*Frontipoda*	3	1
		Oxus	8	1
	Rutripalpidae	*Rutripalpus*	1**	0
	Sperchonidae	*Sperchon*	20+	10
		Sperchonopsis	3*	0
	Teutoniidae	*Teutonia*	2	1
	Torrenticolidae	*Testudacarus*	3	1
		Torrenticola	15	5

Hygrobatoidea	Limnesiidae	*Limnesia*	15	4
		Tyrrellia	2*	0
	Aturidae	*Albia*	2*	0
		Aturus	25	10
		Axonopsis	5*	0
		Brachypoda	3	2
		Diamphidaxona	1	1
		Estellacarus	1	1
		Frontipodopsis	0	0
		Kongsbergia	4	1
		Lethaxona	0	0
		Ljania	1	1
		Neobrachypoda	1	0
		Woolastookia	1	1
	Feltriidae	*Feltria*	15	6
	Hygrobatidae	*Atractides*	10	5
		Hygrobates	15	7
	Pionidae	*Forelia*	10	1
		Huitfeldtia	1*	0
		Hydrochoreutes	4	1
		Najadicola	1	0
		Nautarachna	2	2
		Neotiphys	1	1
		Piona	30	5
		Pionacercus	1*	0
		Pionopsis	2	1
		Pseudofeltria	3	1
		Tiphys	10*	0
		Wettina	2**	0
	Unionicolidae	*Koenikea*	5*	0
		Neumania	15	2
		Unionicola	10	2
Arrenuroidea	Acalyptonotidae	*Acalyptonotus*	1	0
		Paenacalyptonotus	1	1
	Arrenuridae	*Arrenurus*	75	3
	Athienemanniidae	*Chelomideopsis*	1	1
	Chappuisididae	*Chappuisides*	1	1
	Krendowskiidae	*Geayia*	4	0
		Krendowskia	2	0
	Laversiidae	*Laversia*	1	1
	Mideidae	*Midea*	2	0
	Mideopsidae	*Mideopsis*	18	7
		Nudomideopsis	1	1
		Paramideopsis	0	0
	Momoniidae	*Momonia*	1*	0
		Stygomomonia	5	3
	Neoacaridae	*Neoacarus*	4	1
		Volsellacarus	1	1
	Uchidastygacaridae	*Morimotacarus*	0	0
		Uchidastygacarus	1	1
		Yachatsia	0	0
Total			1048	309

References

Behan, V.M., S.B. Hill and D.K. McE Kevan. 1978. Effects of nitrogen fertilizers, as urea, on Acarina and other arthropods in Québec black spruce humus. *Pedobiologia* 18: 249-263.

Binns, E.S. 1982. Phoresy as migration - some functional aspects of phoresy in mites. *Biol. Rev.* 57: 571-620.

Chant, D.A. and R.I.C. Hansell. 1971. The genus *Amblyseius* (Acarina: Phytoseiidae) in Canada and Alaska. *Can. J. Zool.* 49: 703-758.

Chant, D.A., R.I.C. Hansell, and E. Yoshida. 1974. The genus *Typhlodromus* Scheuten (Acarina: Phytoseiidae) in Canada and Alaska. *Can. J. Zool.* 52: 1265-1291.

Cook, D.R. 1963a. Studies on the phreaticolous water mites of North America: New or unreported genera of Mideopsoidea and Acalyptonotoidea. *Ent. News* 74: 63-70.

_________. 1963b. Studies on the phreaticolous water mites of North America: The family Neoacaridae. *Ann. ent. Soc. Am.* 56: 481-487.

_________. 1963c. Studies on the phreaticolous water mites of North America: New or unreported genera of Aponopsidae. *Am. Midl. Nat.* 70: 110-125.

_________. 1968. New species of *Neoacarus* Halbert and *Volsellacarus* Cook from North America. *Proc. ent. Soc. Wash.* 70: 67-74.

_________. 1974. Water mite genera and subgenera. *Mem. Am. ent. Inst.* 21. 860 pp.

Evans, G.O., J.G. Sheals and D. MacFarlane. 1961. The terrestrial Acari of the British Isles. An introduction to their morphology, biology and classification. Vol.1: Introduction and biology. Trustees of the British Museum, v+219pp.

Farrier, M.H. 1957. A revision of the Veigaiidae (Acarina). *N. Carol. Agric. Exp. Stn Tech. Bull.* 124. 103 pp.

Gregson, J.D. 1956. The Ixodoidea of Canada. *Can. Dep. Agric., Ottawa, Publ. 930.* 92 pp.

Habeeb, H. 1955. North American Hydrachnellae, Acari. XXXII-XXXIV. *Leafl. Acadian Biol.* 7. pp. 1-4.

Hinton, H.E. 1971. Plastron respiration in the mite, *Platyseius italicus*. *J. Insect Physiol.* 17: 1185-1199.

Hoff, C.C. 1949. The pseudoscorpions of Illinois. *Bull. Illinois Nat. Hist. Surv.*, 24: 409-498.

Hughes, A.M. 1976. The mites of stored food and houses. *Ministry Agric., Fish. Food Tech. Bull.* 9. 400 pp.

Hurlbutt, H. 1984. A study of North American *Veigaia* (Acarina: Mesostigmata) with comparisons of habitats of unisexual and bisexual forms. *Acarologia* 25: 207-222.

Jacot, A.P. 1939. Reduction of spruce and fir litter by minute animals. *J. For.* 37:858-860.

Krantz, G.W. 1978. A Manual of Acarology. 2nd ed. Oregon State Univ. Book Stores, Inc., Corvallis. xx + 509 pp.

Krantz, G.W. 1983. Mites as biological control agents of dung-breeding flies, with special reference to the Macrochelidae. Pp. 91-98 *in* M.A. Hoy *et al.* (Eds.), Biological control of pests by mites. *Div. Agric. Nat. Resources, Univ. Calif. Special Pub.* 3304. vi + 185 pp.

Lindquist, E.E. 1979. 12. Acari. Pp. 252-290 *in* H.V. Danks (Ed.), Canada and its insect fauna. *Mem. ent. Soc. Can.* 108. 573 pp.

Lindquist, E.E., B.M. O'Connor, F.V. Clulow and H.H.J. Nesbitt, 1979. Acaridiae. Pp.277-284 *in* H.V.Danks (Ed.), Canada and its Insect Fauna. *Mem. Ent. Soc. Can.* 108. 573 pp.

Marshall, V.G., R.M. Reeves and R.A. Norton. 1987. Catalogue of the Oribatida of the continental U.S.A. and Canada. *Mem. Ent. Soc. Can.* In press.

McMurtry, J.A., C.B. Huffaker, and M. van de Vrie. 1970. Ecology of tetranychid mites and their natural enemies: a review. I. Tetranychid enemies: their biological characters and the impact of spray practices. *Hilgardia* 40: 331-390.

Newell, I.M. 1947. A systematic and ecological study of the Halacaridae of eastern North America. *Bull. Bingham Oceanogr. Coll.* 10: 1-232.

Norton, R.A. 1979. The identity of *Pelopsis nudiuscula* (Acari: Oribatei). *Proc. ent. Soc. Wash.* 81:696-697.

_________ . 1983. Tenuialidae (Acari: Oribatei): new diagnoses for supraspecific taxa. *Acarologia* 24: 203-217.

Rasmy, A.H. and A. W. MacPhee. 1970. Mites associated with apple in Nova Scotia. *Can. Ent.* 102:172-174.

Richards, L.A. and K.W. Richards. 1976. Parasitid mites associated with bumblebees in Alberta, Canada (Acarina: Parasitidae; Hymenoptera: Apidae). II. Biology. *Kans. Univ. Sci. Bull.* 51: 1-18.

Schuster, R. and I.J. Schuster. 1977. Ernahrungs-und fortpflanzungs-biologische studien an der Milbenfamilie Nanorchestidae (Acari, Trombidiformes). *Zool. Anz.* 199: 89-94.

Smith, B.P. 1983. The potential of mites as biological control agents of mosquitoes. Pp. 79-85 *in* M.A. Hoy et al. (Eds.), Biological control of pests by mites. *Div. Agric. Nat. Resources, Univ. Calif. Special Pub.* 3304. vi + 185 pp.

Smith, I.M. 1972. A review of the water mite genus *Nautarachna* (Acari: Parasitengona: Pionidae). *Life Sci. Contr., R. Ont. Mus.* 86: 17pp.

__________. 1976. A study of the systematics of the water mite family Pionidae. *Mem. ent. Soc. Can.* 98. 249 pp

__________. 1977a. A new species of *Mideopsis (Nudomideopsis)* (Acari: Parasitengona: Mideopsidae) from North America. *Can. Ent.* 109: 533-535.

__________. 1977b. Descriptions of larvae of some axonopsine water mites (Prostigmata: Parasitengona: Ateridae), with notes on phylogenetic affinities of the subfamily. *Can. Ent.* 109: 953-966.

__________. 1978. Descriptions and observations on host associations of some larval Arrenuroidea (Prostigmata: Parasitengona), with comments on phylogeny in the superfamily. *Can. Ent.* 110: 957-1001.

__________. 1979. A review o f water mites of the family Anisitsiellidae (Prostigmata: Lebertioidea) from North America. *Can. Ent.* 111: 529-550.

__________. 1982. Larvae of water mites of the genera of the superfamily Lebertioidea (Prostigmata: Parasitengona) in North America with comments on phylogeny and higher classification of the superfamily. *Can. Ent.* 114: 901-990.

__________. 1983a. Description of larvae of *Neoacarus occidentalis* (Acari: Arrenuroidea: Neoacaridae). *Can. Ent.* 115: 221-226.

__________. 1983b. Description of larvae of *Nudomideopsis magnacetabula* (Acari: Arrenuroidea: Mideopsidae) with new distributional records for the species and remarks on the classification of *Nudomideopsis*. *Can. Ent.* 115: 913-919.

__________. 1983c. Description of adults of a new species of *Uchidastygacarus (s.s.)* (Acari: Parasitengona: Arrenuroidea) from eastern North America, with comments on distribution of mites of the genus. *Can. Ent.* 115: 1177-1179.

__________. 1984a. Descriptions of new species of *Trisetacus* (Prostigmata: Eriophyoidea) from Pinaceae in western North America. *Can. Ent.* 116: 173-182.

__________. 1984b. Larvae of water mites of some genera of Aturidae (Prostigmata: Hygrobatoidea) in North America with comments on phylogeny and classification of the family. *Can. Ent.* 116: 307-374.

__________. 1984c. Review of species of *Trisetacus* (Acari: Eriophyoidea) from North America, with comments on all nominate taxa in the genus. *Can. Ent.* 116: 1157-1211.

Smith, I.M. and E.E. Lindquist. 1979. Prostigmata. Pp. 267-277 *in* H.V. Danks (Ed.), Canada and its Insect Fauna. *Mem. ent. Soc. Can.* 108. 573 pp.

Smith, I.M. and D.R. Oliver. 1976. The parasitic associations of larval water mites with imaginal aquatic insects, especially Chironomidae. *Can. Ent.* 108: 1427-1442.

__________. 1986. Review of parasitic associations of larval water mites (Acari: Parasitengona: Hydrachnida) with insect hosts. *Can. Ent.* 118: 407-472.

Springett, B.P. 1968. Aspects of the relationship between burying beetles, *Necrophorus* spp. and the mite, *Poecilochirus necrophori* Vitz. *J. Animal Ecol.* 37: 417-424.

Tamura, H. and N. Enda. 1980. Mesostigmatic mites associated with Japanese pine sawyer beetle. *Jap. J. appl. Ent. Zool.* 24: 54-61 (in Japanese, English summary).

Wiggins, G.B., R.J. Mackay and I.M. Smith. 1980. Evolutionary and ecological strategies of animals in annual temporary pools. *Arch. Hydrobiol./Suppl.* 58: 97-206.

Wright, B. 1979. Mites, ticks, fleas, and lice in the Nova Scotia Museum and Acadia University Museum collections. *Proc. N.S. Inst. Sci.* 29: 185-196.

Class Diplopoda (millipedes)

by J.E.H. Martin and S. Allyson

Millipedes are usually found in damp places - under leaves, in moss, under stones, in rotting wood, or in soil. Most millipedes are scavengers and feed on decaying plant material and fungi but a few attack living plants causing damage in greenhouse and gardens; some are predaceous. They vary in size from a few millimeters to about ten centimeters. *Narceus* spp. are the largest. They overwinter in the adult stage in protected situations, and lay their eggs during the summer. Some species construct a nestlike cavity in the soil in which they deposit their eggs; others lay their eggs in damp places. Most species are active at night, especially when the weather is warm and moist. The Canadian fauna is not well-known, the total number of millipedes in all categories is probably about 70 species. The following species have been reported from Nova Scotia (Jawlowski, 1939) and probably occur in the Park.

Polyxenus lagurus (Linné)
Brachydesmus gladiolus Williams and Hefner
Polydesmus sp.
Trichopetalum sp.
Proteroiulus fuscus (Am Stein)
Blaniulus guttulatus Bosc.
Nopoiulus palmatus (Nemec)
Ophyiulus fallax (Meinert)
Microbrachyiulus littoralis (Verhoeff)
Cylindroiulus frisius (Verhoeff)
Cylindroiulus teutonicus (Pocock)

Reference

Jawlowski, H. 1939. Contribution to the knowledge of the Diplopoda of Nova Scotia and Newfoundland. Fragm. Faun. Mus. Zool. Pol., Warszawa, 4, No. 8.

Class Chilopoda (centipedes)

by J.E.H. Martin and S. Allyson

Centipedes occur in protected situations such as in the soil, under stones and bark and in rotten logs. They are active, fast running predaceous animals feeding on insects, spiders and other arthropods. All centipedes possess poison jaws with which they paralyze their prey. Centipedes overwinter as adults in protected places and deposit their eggs singly in the soil in the summer. The Canadian fauna is not well-known and only an introduced species, *Geophilus electricus* (Linnaeus) has been recorded from the Park; although, probably many more species occur there.

The class is divided into four orders: Scolopendromorpha are mainly a tropical group that is not likely to be found in the Park; Geophilomorpha includes many species that are introduced (*G. electricus*, family Geophilidae); other native species probably occur in the Park; Lithobiomorpha are short legged centipedes that occur under stones, bark, logs or other similar habitats and probably occur in the Park; Scutigeromorpha - only one species *Scutigerella coleoptrata* (Linnaeus), the house centipede, occurs in Canada and although its natural habitat is under stones it is frequently found in heated buildings where it feeds on a variety of arthropods including flies, spiders, cockroaches, etc.

Class Symphyla

by J.E.H. Martin and S. Allyson

These are slender whitish myriapods 1-10mm in length, which live in humus soil, decaying wood or other damp situations, feeding on vegetable matter. Only one species has been recorded from Canada, *Scutigerella immaculata* (Newport); it sometimes causes severe damage to the roots of crops. Specialized collecting may locate this species in the Park, as well as other species not yet known from Canada.

Class Insecta (insects)

The insects are the most diverse group of organisms known. Most recent estimates place the number of species in the tens of millions. In tropical areas, only a fraction of species have been described and named. In Canada, most groups of insects are relatively well known; although, there are some poorly known families. The insects that occur in Cape Breton Highlands National Park are classified in twenty-eight orders. A synopsis of these orders, with reference to particularly significant species or groups, is given below.

Order Protura

by J.E.H. Martin and S. Allyson

These small primitive wingless insects, less than 1.5mm in length, usually inhabit moist soil where they feed on decomposing organic matter. Only three species have been recorded from Canada; although, others may occur. They have not been recorded from the Park but like Symphyla, they may be found with specialized collecting.

Order Collembola (springtails)

by J.E.H. Martin and S. Allyson

The springtails are a fairly large group of minute to small, mostly soil or humus inhabiting arthropods. Some workers consider them to be primitive insects but their relationship remains uncertain. Their main source of food is fungal hyphae, but dead and decaying plants, bacteria, algae and spores are also eaten. Some species feed on roots, aerial portions of plants and pollen of living plants; others are associated with plants as pollinators.

One of the best known features of Collembola is mass emergence, or swarming, a phenomenon that is most commonly noted when they occur in incredible numbers on the surface of snow; "snow fleas" (*Hypogastrula socialis* (Uzel)) is perhaps the best known species because of this habit. Other common species are *Achorutes armatus* (Nicolet), the armoured springtail, which occurs in leaf litter, rotting wood and other similar habitats; *Tulbergia granulata* Mills is abundant in agricultural soils; *Isotomurus palustris* (Muller), a marsh springtail, occurs in moist woodlands and is sometimes found on the surface of fresh water; and *Bourletiella hortensis* (Fitch), the garden springtail, occurs on flowers and vegetables, and may cause considerable damage.

The Collembola are divided into two suborders, which comprise nine families with several hundred species; however, collecting in Canada has been so inadequate that meaningful information on the number of known species cannot be tabulated. Probably 200 or more species occur in the Park, many of which may be new to science. A study of the Collembola of the Park would require many years to complete.

Order Diplura (diplurans)

by J.E.H. Martin and S. Allyson

These are small, secretive, nocturnal insects, found most abundantly in damp places under dead leaves, vegetable mold, litter, rocks, logs, bark and in soils rich in humus. They move rapidly and seek concealment as soon as possible. Their food consists of living and dead vegetable matter, fungi and perhaps also tiny animal life.

There are about 25 species in North America distributed among four families: Japygidae, Anajapygidae, Propjapygidae and Campodeidae. Campodeid diplurans are the most common and widely distributed. Representatives of this group have been collected in the Park but have not been identified.

Order Microcoryphia (jumping bristletails)

by J.E.H. Martin and S. Allyson

This group is included by some authors with the Thysanura and the order comprises the single family Machilidae. They occur in dead wood, in leaf litter, under bark and stones and probably feed on humus and algae. Although not recorded from the Park, representatives of the family probably occur there.

Order Thysanura (silverfish)

by J.E.H. Martin and S. Allyson

Canadian Thysanura all belong to the family Lepismatidae of which the two best known members of the family are the silverfish *Lepisma saccharina* Linnaeus and the firebrat *Thermobia domestica* (Packard). These are cosmopolitan domestic species inhabiting heated buildings and feeding on starchy substances. They frequently become pests in libraries where they feed on the starch in books, bindings and labels. Non-domestic lepismatids may be found in caves, leaf litter, and nests, etc. but have not been recorded from the Park.

Order Ephemeroptera (mayflies)

by J.E.H. Martin and S. Allyson

Mayflies are considered to be the oldest and most primitive of the existing winged insects. All species have aquatic nymphs; some 300 species have been recorded from Canada. The short-lived terrestrial adults do not feed and live from only a few hours to a few days. In some species, hatching, mating, egg laying, and death take place within a few hours. The nymphs inhabit a wide variety of aquatic habitats. Many species are highly susceptible to water pollution and are good indicators of water quality. The larvae feed on plant material and other debris carried by the water and are the preferred food of many insects and fishes. The various stages and species serve as models for fishermens' flies, especially those used by trout fishermen. Adults often "hatch" by the millions and become a nuisance around lights or on bridges during these mass emergences. There are 15 families of mayflies found in Canada. Adults occur from May to October, with the greatest numbers of species emerging in June and July. The species recorded from the Park are:

Ameletus tertius McD.
Siphlonurus barbaroides McD.
S. quebecensis (Prov.)
Baetis flavistriga McD.
B. pygmaeus (Hagen)
B. rusticans McD.
Centroptilum album McD.
C. victoriae McD.
Pseudocloeon dubium (Walsh)
Heptagenia hebe McD.
Heptagenia limbata occulta (Walker)
Stenonema fuscum (Clem.)
S. rubromaculatum (Clem.)
S. tesselata Wlk.
Habrophlebia vibrans Needham
Habrophlebiodes americana (Banks)
Leptophlebia concinna Wlk.
L. pallides Wlk.
Paraleptophlebia debilis Wlk.
P. guttala (McD.)
P. moerens (McD.)
P. mollis (Eaton)
P. praepedita (Eaton)
P. volitans (McD.)
Ephemerella bicolor (Cem.)
E. bicoloroides McD.
E. cornuta Morgan
E. funeralis McD.
E. invaria (Wlk.)
E. molita McD.
E. prudentalis McD.
E. serratoides McD.
E. sordida McD.
Epeorus pleuralis (Banks)

Order Odonata (dragonflies, damselflies)

by J.E.H. Martin and S. Allyson

The dragonflies are a small, well known order of insects with 194 species being found in Canada, of which about 40 occur in the Park. They are predators and are exceptional among insects in being carnivorous in both the nymphal and adult stages. Although large numbers of mosquitoes, and other insects troublesome to man, are eaten they are not selective in their prey and effective control on any one species is limited. The larger species often prey on smaller species, especially when there is a high concentration of species and individuals. The larvae of all species are aquatic and are found in almost every kind of freshwater habitat that is productive enough to supply their food requirements. Most species overwinter in the nymphal stage; although, a few species spend the winter in the egg stage hatching in early spring. There is usually one generation a year, but some species require from two to four years to develop. There is a succession of species with adults emerging from May to September. A few adults linger on until heavy frosts in late October.

Suborder Zygoptera (damselflies)

There are three families of this suborder found in Canada and representatives of each occur in the Park.

Family Calopterygidae (broad-winged damselflies)

These are large damselflies that occur along streams.

Calopteryx maculata (Beauvais)

This common damselfly may be found in July and August near small shaded streams with intermittent rapids. It was found at Round Lake, Freshwater Lake and Warren Lake.

Family Lestidae (spread-winged damselflies)

Spread-winged damselflies are common around swamps and ponds, where they alight on grasses and plant stems. The species of *Lestes* frequent still, marshy or bog-margined, waters, usually ponds or small sheltered lakes. Several of our species frequently develop in temporary ponds and probably all have a one-year life cycle. They fly low over the water and come to rest on emergent vegetation, usually within two or three feet of the water, with the body somewhat inclined and the wings half spread. Their flight is not swift and they are generally easily captured. All of the species, so far as known, oviposit in standing aquatic plants, such as *Typha, Scirpus, Sparganium* and *Eleocharis* or even on willow branches and grass stems.

Lestes dryas Kirby

It is easily recognized by its relatively bright metallic green color; it occurs near ponds, or pond-like expansions in slow streams. It was found at Freshwater Lake.

Lestes disjunctus Selys

This rather small to average size damselfly was common around most lake edges. It flies in July and August. This is a widely distributed and abundant species in the Park, inhabiting permanent ponds with marshy or boggy margins, marshy bays and weedy streams.

Family Coenagrionidae (narrow-winged damselflies)

Most North American damselflies belong to this family. These damselflies occur in a variety of habitats; some occur chiefly along streams, and others around ponds. Most of them are rather feeble fliers, and when alighting, usually hold the body horizontal with the wings folded together over the body. The two sexes are differently colored in most species, with the males more brightly colored than the females.

Argia moesta Hagen

Our largest and most abundant eastern *Argia* is common around rocky shores of streams and lakes, and may be found in June, July and August.

Nehalennia irene Hagen

It can be observed in June and July near almost all still waters that support a stand of emergent vegetation, e.g., spring-fed ponds among cat-tails; shallow clay-bottomed sloughs amidst rushes, sedges, and horse-tails; oxbow ponds with any or all of these types of standing aquatic plants; or the marginal zone of slow streams, dominated by cat-tails and *Sparganium* with many other aquatic plants, such as *Iris versicolor, Sium suave*, and *Calla palustris*; and bog ponds of all sorts. In all these situations *N. irene* abounds in summer, flying close to the water among the rushes or other emergent plants, and in the grass and sedge along the shore, but usually not venturing over the open water. Except in the far north, this is probably the most abundant damselfly in eastern Canada.

Nehalennia gracilis Morse

In contrast to *N. irene, N. gracilis* is almost entirely restricted to one type of habitat, the sphagnum-bog pond. Like *N. irene, gracilis* flies low over the wet sphagnum moss and among the slender branches of cranberry and other bog plants. They skirt the edge of plants on pond margins but avoid the open water. The flight period is June and July. There are no records of this species from the Park, although it probably occurs in suitable habitats.

Enallagma hageni Walsh

An inhabitant of marshy and boggy ponds, lake shores and slow streams, this species can be found in June, July and August.

Enallagma exulans Hagen

During June, July and August this long slender *Enallagma* dwells around streams and lake shores, where it is the commonest damselfly of streams. *E. exulans* is most abundant on small rivers and brooks, where it flies over the water close to the bank, often hovering over one spot a foot or two above the water surface. Occasionally it makes a wider excursion over the stream, soon returning to the shelter of the bank. It does not frequent rapids, but seeks the quieter reaches.

Enallagma civile (Hagen)

This species inhabits ponds, lakes and slow streams.

Ischnura verticalis (Say)

Undoubtedly this is the commonest and most generally distributed of all Odonata of hardwood and mixed forest regions in the southern parts of the Eastern Provinces. It can be found in June and July, flying around permanent still waters and slow streams.

Suborder Anisoptera (dragonflies)

Family Aeshnidae (darners)

Darners generally occur around ponds and marshes. These are the large dragonflies with long spear-shaped bodies that are common and conspicuous in late summer when most of the other large Anisoptera have disappeared or declined in numbers.

Basiaeschna janata Say

This is an early aeshnid species, since the adults fly in June. This small species is found near lakes and small forest streams with riffles or gentle currents.

Aeshna eremita Scudder

This large robust and widely distributed species can be seen in July, August and September. It is common around marsh-bordered lakes, ponds and slow streams.

Aeshna interrupta Walker

It is found around or near shallow marsh-bordered bays, boggy or marshy ponds and slow streams in July and August.

Aeshna canadensis Walker

It is commonly found in quiet marshy or bog-margined lakes, ponds or sluggish streams in July and August.

Aeshna umbrosa Walker

The flight of the adults occurs in August and September, when they frequent partly shaded streams, ditches and small forest lakes, flying chiefly in shady places.

Anax junius Drury

This is a large dragonfly that emerges in August. The habitats frequented by *A. junius* are still waters with emergent vegetation, from small semi-permanent ponds to lakes, sheltered bays, and slow streams. *A. junius* is widely distributed.

Family Gomphidae

The Gomphidae are mainly inhabitants of streams, large and small, but some develop in lakes and others even in marshy ponds. They are local insects, often extremely abundant for a short flight period but, on the whole, not very common in Canada except in the more southerly parts of the eastern provinces.

Hagenius brevistylus Sélys

This is a very large black and yellow-green dragonfly that dwells near forest streams or along rocky channels with more or less perceptible current. Adults can be found in June, July and August.

Ophiogomphus carolus Needham

This species inhabits rapid streams with sandy bottoms. It is distributed from Nova Scotia to western Ontario.

Ophiogomphus aspersus Morse

This species is restricted to clear cold rapid stream species in eastern Canada.

Lanthus albistylus Hagen

This small, slender, dark gomphid inhabits shallow rapids of clear streams with projecting stones. Adults can be caught in June and July. Their flight is very rapid and close to the water.

Lanthus parvulus (Sélys)

This species inhabits small spring-fed streams with projecting stones. Nova Scotia is the type locality of this species. It ranges from Nova Scotia to the eastern townships of Quebec.

Family Cordulegasteridae

Cordulegaster maculatus Sélys

It frequents rapid streams in woods in July and August. This is the most generally distributed *Cordulegaster* in eastern Canada.

Cordulegaster diastatops Sélys

The adults can be seen in July and August. This relatively small species inhabits spring runs and brooks with rapids and pools, typically in clearings or bushy pastures.

Family Corduliidae

Epitheca cynosura (Say)

This average-sized species dwells in marsh-bordered lakes, bays and mouths of slow streams with submerged and emergent vegetation; adults fly in June and July.

Epitheca spinigera (Sélys)

This very dark species is variable size; it may be larger than any other Canadian species of *Epitheca* except *princeps*. Adults frequent marshy borders of lakes and slow streams; they fly in June and July.

Epitheca canis McLachlan

This species inhabits bog ponds with acid waters; adults occur in June and July.

Somatochlora minor Calver

Adults occur commonly in July and August near clear, gently flowing, forest streams.

Cordulia shurtleffi Scudder

This species is the commonest and most widely distributed species of its family in Canada. It occurs around marshy or boggy waters, sphagnum bog ponds and small lakes in June and July.

Family Libellulidae

Libellula quadrimaculata Linnaeus

This species inhabits still waters in marshy or boggy areas.

Libellula julia Uhler

Inhabits bog ponds and swampy bays; adults occur in June and July.

Sympetrum semicinctum Say

Spring-fed ponds and marshes are the habitats of this species. Adults fly in July and August.

Sympetrum internus Montgomery

This species occurs around ponds and slow shady streams. The adult flight period is from June to October.

Sympetrum obtrusum Hagen

This species occurs around small ponds in fields, pastures and gravel pits and flies from June to October.

Leucorrhinia hudsonica Sélys

The habitat of this species is cold marshy waters and bog ponds. The flight period is June and July.

Leucorrhinia glacialis Hagen

This widely distributed species frequents bog lakes and marshes from Newfoundland to British Columbia. The flight period is June and July.

Leucorrhinia intacta Hagen

Marshy ponds, bays and slow streams are inhabited by this insect. The adults fly in June and July. It ranges from Nova Scotia to British Columbia.

Leucorrhinia proxima Calvert

The habitat of this species is still marshy or bog waters. The period of flight is June and July. A widespread species, it occurs from Nova Scotia to British Columbia and north into the Northwest Territories and Yukon.

Leucorrhinia frigida Hagen

This species is found in bog lakes and ponds, especially those with floating sphagnum. It occurs from Nova Scotia to western Canada.

Order Plecoptera (stoneflies)

by J.E.H. Martin and S. Allyson

There are some 250 species recorded from Canada with perhaps 35 species occurring in the Park of which 32 have been recorded. All species have aquatic nymphs most of which are restricted to cool, clear, running water; although some species breed in cold, well oxygenated lakes. Few species can develop in warm, poorly oxygenated, silted or polluted waters and like the mayflies, they are good indicators of water quality. Some species feed as nymphs on plant material, algae and detritus particles; others are carnivorous and predatory on aquatic insects such as black fly larvae. Nymphs and adults are food for other aquatic animals. The adults of some species probably do not feed; others have been recorded feeding on algae and plant buds. Adults live three to four weeks; the eggs are laid in or on the water. Adults remain close to the larval habitat, being found on bridges over streams, or vegetation close to water. There is a succession in the appearance of the adults of the various species throughout the year with species of *Allocapnia* emerging in March. These insects can readily be found crawling on the snow near streams or rivers. Some species are attracted to lights.

The following species probably occur in Cape Breton Highlands National Park:

Leuctra duplicata Claassen
Leuctra sibleyi Claassen
Leuctra tenella Provancher
Leuctra tenuis (Pictet)
Amphinemura delosa (Ricker)
Amphinemura wui (Claassen)
Nemoura trispinosa Claassen
Paranemoura perfecta (Walker)
Podmosta macdunnoughi (Ricker)
Shipsa rotunda (Claassen)
Allomarcys comstocki (Smith)
Neoperla clymene (Newman)
Phasganophora capitata (Pictet)
Acroneuria abnormis (Newman)
Perlesta placida (Hagen)
Isoperla bilineata (Say)
Isoperla marlynia Needham & Claassen
Isoperla montana (Banks)
Isoperla sp. nr. *orata* Frison
Isoperla signata (Banks)
Isoperla transmarina Newman
Alloperla banksi Frison
Alloperla caudata Frison
Alloperla chloris Frison
Alloperla imbecilla (Say)
Alloperla neglecta Frison
Alloperla voinae Ricker
Alloperla vostoki Ricker
Hastaperla brevis (Banks)
Sweltsa naica (Provancher)
Sweltsa onkos (Ricker)
Isoperla truncata Navas

The Orthoperoid insects of Cape Breton Highlands National Park

by J.E.H. Martin and S. Allyson

The "orthopteroids" constitute an associated group of insects: grasshoppers, crickets, walking sticks, mantids, cockroaches and earwigs. Probably about 20 species occur in this area; they occur in all terrestrial habitats. Although some are pests in various parts of Canada, causing damage to crops and pasture, they are unlikely to become numerous enough to cause damage in the Park. As the forest encroaches on former farmland, the numbers of those species found in these habitats will decrease and, in some cases, species will be limited to the roadsides.

These insects are active from May until severe frosts in October or early November. No species has more than one generation a year and the inactive or hibernating period may be spent in the egg, as a nymph, or as an adult, depending on the species. Food consists of a wide variety of vegetation and fungi; some species even nibble on raw meat. The orthoperoids, in turn, serve as food for many birds and mammals. Many species stridulate and the songs of crickets and katydids on warm summer evenings are familiar to many.

Order Dictuoptera

Suborder Blattodea (cockroaches)

Superfamily Blaberoidea

Family Blattellidae

The German cockroach, *Blattella germanica* (Linnaeus) is a common pest species in houses, restaurants, etc. where conditions are not always sanitary. It is a species that was introduced into Canada and although not collected in the Park, it could occur in buildings within the Park boundaries.

Order Dermaptera

Suborder Forficulodea (earwigs)

Superfamily Spongiphoroidea

Family Labiidae

Labia minor (Linnaeus)

This very small earwig was probably introduced from Europe. It is not economically important and although widespread, it is seldom common. It has been recorded from Nova Scotia and proably occurs in the Park. It is attracted to light.

Superfamily Forficuloidea

Family Forficulidae

Forficula auricularia Linnaeus European earwig

This introduced pest has become common in parts of eastern Canada. It has not been recorded from the Park but may occur there by being transported by vehicles.

Order Grylloptera

Suborder Tettigoniodea

Superfamily Rhaphidophoroidea

Family Rhaphidophoridae

Ceuthophilus spp. camel or cave crickets

These interesting insects are seldom seen, being nocturnal in habits; during the day they hide veneath stones, logs, stumps and in mammal burrows often several associated together. They are omnivorous in their choice of food and are readily attracted to molasses bait. Being wingless they are silent and like most other silent creatures are probably deaf, as no trace of an ear-drum is visible.

Ceuthophilus maculatus (Harris)

This is the most common camel cricket, being found in a variety of habitats. It occasionally invades damp basements but does not cause damage. Adults and nymphs have been collected from June to August at Lone Shieling.

Superfamily Tettigonioidea (longhorn grasshoppers)

Family Phaneropteridae

Scudderia furcata Bruner von Wattenwyl forktailed bush katydid

This katydid has been recorded from Nova Scotia and probably occurs in the Park.

Family Tettigoniidae

Metrioptera roeselii (Hagenbach)

Introduced into the Montreal area from Europe in the late 1940's or early 1950's, it has spread rapidly. It is a grass feeder, preferring timothy. It is common in abandoned farmland, and probably will eventually occur in the Park.

Family Conocephalidae

Conocephalus fasciatus (DeGeer)

The slender meadow katydid is common in damp meadows. It occurs from July until October and has been collected at Pleasant Bay.

Suborder Gryllodea

Superfamily Grylloidea

Family Gryllidae

Subfamily Gryllinae

Gryllus pennsylvanicus Burmeister fall field cricket

This is the common cricket found along roadsides and other waste places in the Park. It has been collected near Lone Shieling.

Subfamily Nemobiinae (ground crickets)

These small ground crickets are the most numerous of the crickets and are found in many habitats where they feed on grasses, carrion, and dung. They are very musical and their song can be heard from late July until the first severe frost in the fall.

Allonemobius fasciatus (DeGeer)

This species has been collected near Lone Shieling and probably occurs in damp meadows in other areas along with the following species.

Allonemobius allardi (Alexander & Thomas)

This species is found in a wide range of habitats ranging from dry sandy areas to damp stream or river banks. It has been recorded in the Park near Lone Shieling.

Order Orthoptera

Suborder Acridodea

Superfamily Acridoidea

Family Acrididae

Melanoplus spp.

These are the commonest of the grasshoppers. Several species occur in the Park area, and many are known to cause crop damage in other parts of Canada. Additional collecting may record additional species of this genus in the Park.

Melanoplus bivittatus (Say) two striped grasshopper

This is a large species and one of the most numerous in eastern Canada; it occasionally causes crop damage. It is found in southern Canada as far north as Newfoundland; it frequents fields, pastures, prairies and roadsides. Adults occur from July-September and it is widely distributed in the Park in suitable habitats. Specimens have been collected near Lone Shieling, Pleasant Bay and Warren Lake.

Melanoplus femurrubrum (DeGeer) redlegged grasshoper

This species inhabits the same areas as *M. sanguinipes*. It is probably the most common grasshopper of this area. It occurs all over North America and is found in the adult stage from early July to October.

Melanoplus sanguinipes (Fabricius) migratory grasshopper

This species is found in meadows and roadsides and is a serious pest in western Canada. A common species in the Park, it has been collected from July to September.

Camnula pellucida (Scudder) clearwinged grasshopper

This species is known from every province in Canada; it is a grass feeder, usually found in dry locations. It is the most important economic species in Canada and can cause considerable crop damage. Adults are in the field from July to September; the species was found near Jigging Cove Lake.

Dissosteira carolina (Linnaeus) Carolina grasshopper

This very common species is recorded from Cape Breton Island. It prefers sandy or gravelly areas where there are bare patches of earth; it frequently rests on roads, railway cuttings and in gravel pits. Males often hover and resemble the mourning cloak butterfly with their distinctive black hind wings with a pale yellow marginal band. Adults occur from July to September.

Trimerotropis verruculatus (Kirby)

This species is often found in open gravel, or rocky areas, where it basks in the sunshine. The "song" is the loudest produced by any of our locusts and when in flight it makes a loud sharp snapping or cracking sound. From this sound it is sometimes called the Snapper or Cracker. Adults are found from late July-September. They have been collected near Lone Shieling, Pleasant Bay and near Cheticamp.

Stethophyma gracile (Scudder)

This species is a sedge feeder and is found in wet meadows and bogs. Adults occur in July and August; it has been recorded from French Lake and North Mountain.

Chorthippus curtipennis (Harris)

This widely distributed species is found in all provinces and territories in Canada. It is found in thick grasses, in damp places, dry meadows and roadsides. It has been collected at Pleasant Bay, North Mountain, near Lone Shieling and MacKenzie Mountain in July and August.

Suborder Tetrigodea
Superfamily Tetrigoidea

Family Tetrigidae

The grouse or pygmy locusts are the smallest locusts and are among the smallest of the Orthoptera. These interesting and odd-shaped insects are peculiar in that they almost invariably alight on the ground. The remarkable coloration of grouse loccusts produces an excellent match with the color and pattern of the soil on which they occur; this pattern resemblance can make it difficult to locate them. The protective resemblance is carried out to perfection in that the soil, scattered with debris bleached out by the hot sun, and the patterns of lights and shadows are copied exactly. No shade, color or arrangement of marking seems impossible to simulate, and every individual is a study in color harmony. They overwinter in the late nymphal stage and as adults. Adults are collected in September and October and in early Spring in April and May.

Tetrix subulata (Linnaeus)

This widely distributed species occurs in northern Europe, Asia and much of northern North America. It is found in grassy areas in a variety of habitats from marshy or boggy lake shores to drier cultivated or forested areas. It overwinters in the adult stage.

Family Batrachideidae

Tettigidea lateralis (Say)

This robust species tends to be larger than the preceding species; it is found in damp habitats near streams and swampy areas. It hibernates as an adult.

Order Psocoptera (booklice, psocids)

by J.E.H. Martin and S. Allyson

The psocids are small, soft-bodied, primarily tropical insects, with probably about 100 species occurring in Canada. Wings may be present or absent, and both long-winged and short-winged individuals occur in some species. Winged forms usually have two pair of membranous wings which are held rooflike over the abdomen when at rest. They feed on molds, fungi, cereals, pollen, dead insects and similar material. The booklice *Liposcelis* spp., which are wingless, commonly occur in domestic situations often becoming pests of stored grains and cereal products. In books they have been known to feed on the starch in bindings and labels. Out of doors, psocids are found on the ground among leaves and litter, on shrubs, trees, fences, logs, on fungi, and in nests of birds, rodents, wasps, and ants. This group was not collected in the Park but probably 25 species occur there.

Order Mallophaga (chewing lice)

by J.E.H. Martin and S. Allyson

The Mallophaga are ectoparasites of warm-blooded animals, chiefly birds, though a small number of species are restricted to mammals. They feed on bits of hair, feathers, or skin of the host and, in sufficient numbers, cause great irritation. Most species occur on only one host and in some groups it is not uncommon to find a different species of lice on hosts that differ only subspecifically. More than one species, genus, or family may live on the same host. So far as is known, distributions of the species correspond largely with those of the hosts. Specimens are usually collected from the host after it has been shot or trapped; although, road kills, if fresh, may have ectoparasites remaining in the feathers or fur. No records are available from the Park, although each species of bird or mammal is probably a host for the group.

The order is divided into two suborders, comprising eight families.

Suborder Ischnocera

The family Philopteridae is distributed over a wide variety of hosts, including ducks, grouse, birds of prey, song birds, doves, and herons. Several important pest species found on poultry belong to this family. The family Trichodectidae infest mammals, and several species are important pests of livestock and pets.

Suborder Amblycera

Family Menoponidae. This family is found on shore birds, song birds, and grouse. Some species are pests of poultry.

Family Ricinidae. This is a small group that occurs on song birds and hummingbirds.

Family Laemobothriidae. The only genus, *Laemobothrion*, is found on coots, gallinules, grebes, vultures, and birds of prey.

Family Boopidae. One species, *Heterodoxus spiniger* (Enderlein), is found on domestic dogs and on coyote.

Order Anoplura (sucking lice)

by J.E.H. Martin and S. Allyson

The sucking lice is a small group that lives exclusively on mammals and feeds on the blood of their hosts. As in the Mallophaga, there is considerable host specificity and similar species tend to be found on closely related hosts. The entire life cycle is spent on the host. The eggs, called nits, are glued to a hair; they hatch into nymphs that are very similar to the adults in both appearance and habits. Breeding occurs continuously through the year. The importance of human lice as vectors of disease, particularly typhus, trench fever and relapsing fever, is well established. Also, the economic importance of lice on domestic animals is well-understood, and similar affects in heavily infested hosts must apply to many mammals in the wild. Thirty-three species have been recorded from Canada.

The group comprises fifteen families, a few of which probably are found on mammals in the Park:

The Family Enderleinellidae occurs on squirrels.

The Family Hoplopleuridae occurs on rodents, rabbits and hares.

The Family Linognathidae occurs on hoofed mammals and carnivores.

The Family Pediculidae includes the body louse, *Pediculus humanus* Linnaeus, which occurs on man.

The Family Polyplacidae occurs on rodents.

The Family Pthiridae includes the crab louse, *Pthirus pubis* Linnaeus, which occurs on man.

Order Homoptera

by K.G.A. Hamilton

The Homoptera are sucking insects provided with a jointed beak arising from the back of the head; they may be free-living or parasite-like, with greatly reduced sclerotization and poorly developed appendages. The free-living adults have a less strongly sclerotized body than Heteroptera, a head broadly joined to the thorax, multisegmented filiform (often bristlelike) antennae, and enlarged hind legs fitted with spines or setae, capable of producing powerful leaps.

The free-living forms are very differently represented in both scientific studies, and in the Park fauna. A few groups are well studied, or poorly represented from the Park; but many will require much additional study before any reasonable analysis of the many species in the Park can be presented.

By conservative estimate, there should be 300 species of Homoptera in the Park. This contrasts with an estimate of 2,000 species in Canada as a whole.

Census of Cape Breton Highlands National Park Homoptera

Family	No. species known in eastern Canada	Est. species in Park	Species known from Park
Cicadellidae	600	188	145
Cercopidae	25	8	6
Membracidae	60	6	4
Cicadidae	5	2	2
Fulgoroidea	80	10	7
TOTAL	770	214	164

Family Cicadellidae

Cicadellidae, or leafhoppers, are small, streamlined insects which jump actively and powerfully. Adults resemble spittlebugs in size and shape, but may be distinguished by their long hind tibiae fringed with setae. They may also be distinguished by their walking gait: on flat surfaces they travel obliquely, and on twigs they move in a helix. Leafhoppers suck plant juices from stems and twigs, or dissolve leaf tissue causing pale spots ("hopperburn") to appear on the upper sides. Their feeding not only causes loss of plant growth, but may also transmit viral and fungal diseases.

The Cicadellidae is a large family, with over 15,000 described species in the world fauna, and some 1,000 species likely to occur in Canada. Most of the anticipated species have been found in the Park, with 145 recorded to date. Collecting in more wetland habitats will probably turn up additional interesting species.

Leafhoppers can occur abundantly in many habitats. Grasses are frequently infested with *Amplicephalus (Endria) inimicus* (Say), *Latalus ocellaris* (Fallén), *Diplocolenus (Verdanus) evansi* (Ashmead), *Balclutha impicta* (Van Duzee) and many other species; *Graphocephala picta* (Walker), *Aceratagallia sanguinolenta* (Provancher) and *Empoasca fabae* (Harris) are common on weeds; *Empoasca splendida* Gillette, *Ribautiana unca* (McAtee), *Typhlocyba latifasciata* (Christian), and *Oncopsis flavidorsum* (Amyot & Serville) are abundant on alder bushes; aspen is commonly attacked by *Idiocerus lunaris* Ball, *Macropsis basalis* (Van Duzee) and other species; *Oncopsis minor* (Fitch) is abundant on paper birch; and *Typhlocyba pomaria* McAtee feeds on many trees. Sedges and reeds on marshes support large populations of *Helochara communis* Fitch, *Draeculacephala* spp. and *Macrosteles fascifrons* (Stal).

Many leafhoppers are brightly coloured, but their small size often renders them inconspicuous. Among the larger species, the most distinctive are: *Graphocephala picta*, blue-green with red stripes; *Oncopsis variabilis* (Fitch), the females of which are yellow, usually patterned in orange or black; and *Oncopsis sobria* (Walker), the females of which are orange, the males nearly black with a vivid violet sheen.

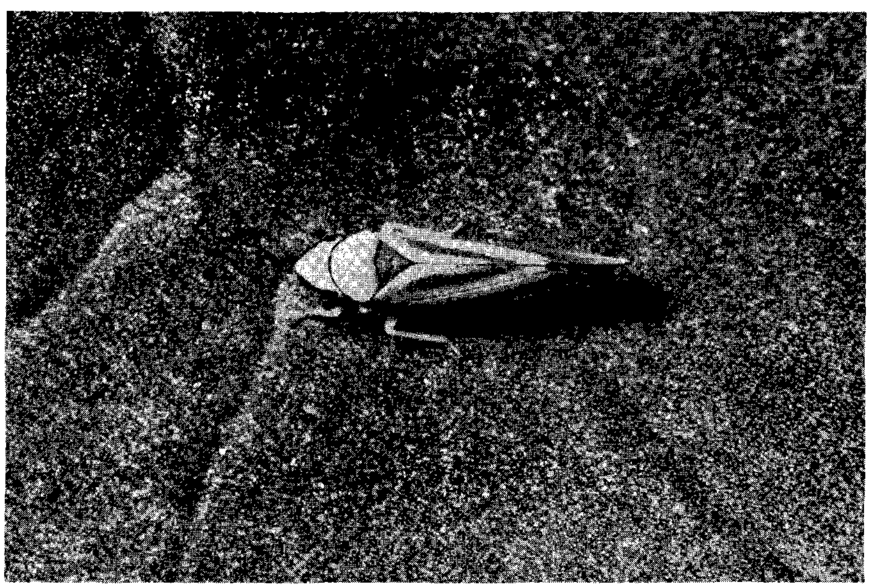


Fig. 1. *Graphocephala picta* (Walker) is a common Park leafhopper on herbaceous plants around wood edges. Its red and green wing stripes render it conspicuous.

Nine leafhoppers in the Park are recent introductions from Europe: *Latalus ocellaris*, *Aphrodes bicinctus* (Schrank), *Elymana sulphurella* (Zett.), *Sorhoanus pascuellus* (Fallen), *Anoscopus flavostriatus* (Donovan), *Euscelis sordida* (Zetterstedt), *Deltocephalus pulicaris* (Fall.), *Doratura stylata* (Boheman) and *Athysanus argentarius* Metcalf. The number of introduced species is small compared to the 64 such species known at present in North America. This is probably a function of the relatively few introduced European plants in the Park.

The Park has yielded many interesting leafhopper records. At least 11 are undescribed species, and 62 are new records for Nova Scotia, of which 19 represent extreme range extensions from the north or west.

Xestocephalus flavocapitatus Van Duzee is a common but poorly studied species, with no known immatures. Adults of a related species have been sifted from earth that also contained ants, so it may be an ant associate. This is also suggested by its deep antennal pits and cylindrical body, that could be adaptations for underground living.

Family Membracidae

Membracidae, or treehoppers, are bulky insects of strange or grotesque appearance. Some mimic thorns; others, crumpled leaves, buds or seeds; still others look like tiny buffalo, or have other improbable shapes. As in leafhoppers, their feeding on plant fluids causes loss of growth and sometimes stunting of the host plant; egg slits cut in twigs may sometimes cause breakage, or invasion by fungal diseases.

The Membracidae is largely a New-World tropical group, with only 70 species in Eastern Canada. Only 4 of these have been taken in the Park. Most are tree feeders, and are readily collected only by shaking or beating the trees over a sheet. Searching among foliage for these curious insects is a rewarding, if time-consuming, endeavour.

None of the treehoppers recorded from the Park is either rare or of economic significance. *Campylenchia latipes* (Say), *Entylia carinata* (Forster), and *Ceresa basalis* (Walker) are all common species on bushes and weeds. The nymphs of all these species have branching spines along the back, instead of the cape-like pronotum.

Family Cercopidae

Cercopidae, or spittlebugs, are most familiar as the foamy globules on grasses, bushes and pine trees. These are the homes constructed by the nymphs; adult spittlebugs are free-living, stout bugs with tiny antennae and thorny hind legs. Their feeding on plant sap may stunt the growth of plants, cause die-back on evergreens, and may also transmit viral diseases.

The Cercopidae is largely a tropical family, with only 25 species in Eastern Canada, of which 6 are recorded from the Park and 2 others eventually may be found there also. The taxonomy of the family is more nearly complete than that of any other Canadian Homoptera; few additional records and new species are anticipated.

By far the best-known and most economically important species is the introduced European *Philaenus spumarius* (Linnaeus), the meadow spittlebug. This has an enormous variety of colour forms, ranging from all black to pale buff-yellow, or patterned in brown or black and buff or rose-pink. Three highly distinctive forms are: black with a pale head; brown or black with whitish wing margins; buff with three longitudinal black stripes. This species feeds on many decidious trees, shrubs, herbs and grasses.

Other common species include the lined spittlebug, *Neophilaenus lineatus* (Linnaeus), an introduced European species that feeds on grasses in moist places, the boreal spittlebug, *Aphrophora gelida* (Walker); the alder spittlebug, *Clastoptera obtusa* (Say); and the heath spittlebug, *Clastoptera saintcyri* Provancher, which is a pest of blueberries.

Members of the genus *Clastoptera* Germar are nearly circular and shiny, and may easily be mistaken for beetles. Heath spittlebugs, which belong to this genus, often have bold yellow-orange markings across their black bodies.

Family Cicadidae

Cicadas are more often heard than seen. The adult insects, sitting near the tops of trees, are seldom seen although they are more than an inch (3 cm) long. The immatures are even less often noticed; they feed underground, on the roots of trees, and only emerge to molt into the adult stage. The cast larval skins are sometimes found, still clinging to the tree trunk.

The Cicadidae is a tropical and subtropical family with only 5 species known from Eastern Canada, of which 2 occur in Nova Scotia. Both probably occur in the Park. There are a much larger number of species in Western Canada, but the exact number cannot be ascertained since the species limits are difficult to determine.

Superfamily Fulgoroidea

The Fulgoroidea, or planthoppers, are curiously shaped bugs with globular antennae and a long face with two parallel ridges; the wings are often broad, with numerous veins. Some feed on plants; others on fungi. None of the Canadian species are known to have economic importance.

The families of the Fulgoroidea are not readily recognized by the amateur. Delphacidae have a spur-like process on the hind feet, and a very long female ovipositor running the length of the abdomen. Cixiidae lack the spur process and have a shorter ovipositor embedded in waxy filaments at the end of the body.

Family Delphacidae

The Delphacidae are a large group that is poorly studied at present. There are 81 known Canadian species, with many additional ones yet to be recorded. The number in the Park cannot be guessed at, on our present state of knowledge. Only a few have been collected to date.

Family Cixiidae

Eighteen Cixiidae are known from Eastern Canada; only *Cixius basalis* Van Duzee and *Cixius nike* Kramer are known from the Park.

Order Hemiptera

by D.J.E. Brown

This large order consists of small to large, flat-bodied insects that are known as "true bugs". Adults generally have thickened front wings and membranous hind ones. The head has a pair of antennae with five or fewer segments.

The Hemiptera have piercing, sucking mouthparts with a four-segmented beak that is "tucked" under the head. The order includes both terrestrial and aquatic bugs. Many species are plant feeders; others attack animals including other insects.

Many nymphs and adults have scent glands on the upper side of the abdomen that secrete an odoriferous fluid.

There are approximately 320 species of Hemiptera in CBHNP.

Family Pentatomidae (stink bugs)

This family contains the true "stink bugs". The antennae are five-segmented, ocelli are present, the head is usually tapered and considerably narrower than the maximum width of the pronotum. The majority of species are plant feeders, living on their host plants. Some species are occasionally destructive to cultivated plants. Some subfamilies contain predaceous species; several of these are beneficial as predators of destructive species.

Twenty-eight species have been found in the Park and several more may also occur there.

The spined solider bug, *Podisus maculiventris* (Say), a beneficial predaceous stink bug, was found in the flood plains of the Park. It is a medium-sized stink bug which preys on a wide variety of arthropods, especially larvae of Lepidoptera and leaf-eating beetle larvae.

Family Rhopalidae (scentless plant bugs)

These insects are, for the most part, of small size and pale color. They often occur in large numbers, in late summer and autumn, on weeds and other plants growing in open fields and on roadsides. All species are phytophagous.

Family Coreidae (squash bugs)

The members of this family are usually elongate, moderately heavy-bodied bugs. They are predominantly dull brown or gray in color and are medium to large in size. All species are plant feeders. When disturbed almost all of them emit, from large openings on each side of the abdomen, copious quantities of a volatile liquid which has one of the most penetrating and offensive odours in the Order. There are 27 species known in eastern Canada.

Family Lygaeidae (chinch bug family)

This is one of the largest families in the Hemiptera. Of the 1400 species known, 82 occur in eastern Canada and 38 have been collected in the Park. Most species are phytophagous, feeding on the juices of a wide variety of plant species. One species, "the cinch bug", *Blissus leucopterus* (Say), which occurs in the Park, is the most destructive hemipteran known. Several species in the family are sap feeders and a few are predaceous on small insects.

Family Berytinidae (stilt bugs)

These slender, elongate insects have long legs and antennae that give them a thread-legged appearance. The labium and the antenna are both four-segmented. Most species are a dull yellow-brown color. They are all plant feeders and can be found on vegetation or on the ground.

Six species occur in eastern North America; two of these have been collected in the Park. *Berytinus minor* (H.-S.) is a European species that has only recently become established in the Park; it is found around the bases of grass clumps in old pastures and weedy fields.

Family Aradidae (flat bugs)

This is a moderately large family of dorso-ventrally flattened, usually black or brown bugs. They are generally elongate-oval, and the surface appears granular. These curious insects are usually found on or underneath the bark of dead trees where they feed on fungi. Most flat bugs require specialized collecting methods such as stripping bark and searching ground litter. They hibernate in the adult and nymphal stages, often protected only by the bark. Of the 43 species that occur in eastern North America, 18 occur in the Park area.

Family Phymatidae (ambush bugs)

This is a small family with relatively few species in North America. They are stout-bodied, medium sized insects that vary in color from yellow and brown, to black or pale green with darker markings. The fore femora are greatly enlarged; the fore tibiae are sickle-shaped and fit into a groove on the inner surface of the femora. This claw-like structure is used to catch and hold the ambushed prey. All species are predaceous; they hide in the heads of flowers, especially the Compositae, where they wait for bees, butterflies and other nectar-seeking insects. Of the 14 known North American species, three occur in the Park.

Family Reduviidae (assassin, or conenosed, bugs)

This is a large family of small to large, stoutly built, predaceous bugs that live on the ground, on plants and occasionally in buildings. The beak is short and three-segmented; the antenna is slender and four-segmented and the head is narrow and pointed in front. Many species "bite" readily, causing a very painful reaction and they should be handled with caution.

Of approximately 400 eastern North American species, 28 are known to occur in the Park. One in particular, *Reduvius personatus* (Linn.), is known as the "masked bed-bug hunter". It occurs for the most part in houses; both adults and nymphs cover themselves with lint and dust and hide in corners and crevices in wait for their prey. The adults are most common in June; they will fly to lights at dusk.

Family Nabidae (damsel bugs)

Nabids are medium-sized, dull grey, brown or black bugs with elongate bodies and oval abdomens. The front tibiae are armed with spines with which they hold their prey. The antennae are long, slender and four-segmented. Nabids are predaceous; eight species occur in the Park and two more may occur.

The nymphs of some species mimic ants, particularly *Nabis subcoleoptrata* (Kirby); it is found in meadows and feeds primarily on the meadow plant bug *Leptopterna dolabrata* (Linn.).

Family Miridae (plant bugs)

This family contains the plant bugs that feed on plants by sucking out the juices or prey on soft-bodied arthropods such as aphids, psyllids, leafhoppers and mites. The plant bugs can be recognized by the four-segmented antennae, four-segmented beak, the absence of ocelli on the head, and the characteristic hemelytron. Of approximately 600 species in eastern Canada, nearly 300 have been found in Quebec and just over 100 have been collected in the Park.

A handbook on the plant bugs of eastern Canada is in preparation.

Family Cimicidae (bedbug family)

Cimex lectularius Linn. These flat, reddish brown insects live in concealed places and crawl onto people as they sleep to take a blood meal. The bedbug, while now primarily a pest of man, also attacks chickens and bats, and has been reported from many other mammals and birds. It is usually limited to houses where the owner is indifferent or careless, but it can readily be transported to other houses in boxes, suitcases and trunks.

The bedbug is completely nocturnal in habit and shows a certain degree of wariness in its efforts to conceal itself during the day. They are not normally very active during the winter, especially in cold rooms, and usually hibernate in their place of concealment.

Family Belostomatidae (giant water bugs)

These bugs, the largest of our hemipterans, are fairly common in the Park. They are flattened and elongate-oval in form and nearly uniformly dull brown or yellowish brown. The front legs are greatly enlarged and raptorial. They are found in ponds, lakes and quiet waters in streams and rivers. The hind legs are flattened and fringed with long, stiff hair and are used as oars for swimming.

Of the three genera and seven species known in eastern Canada, four species have been found in the Park. All are predators and feed on aquatic insects, small fish, tadpoles and other water dwelling creatures.

During the mating season these bugs fly from one body of water to another. Some of the larger species come regularly to lights, occasionally in very large numbers. In some areas they are known as "electric light bugs" or "toe-biters". They are, however, harmless, but when picked up carelessly can inflict a painful wound with their stout beaks.

The Belostomatidae are predaceous carnivores and feed on a wide variety of invertebrates and any small vertebrate that it can overpower. In times of stress, it will feed on its own nymphs, which may also prey on each other. The bug apparently injects some paralyzing poison into its victim. Ordinarily the prey is seized by the raptorial front legs. Their favourite haunts are in muddy-bottomed ponds where they lurk among the weeds at the bottom.

The eggs of *Belostoma* are laid on the back of a male, which is seized by the female. This tends to protect the eggs from the voracious appetites of other adults.

Family Gerridae (water striders)

These are medium-sized, semi-aquatic Hemiptera with narrow, elongate bodies covered with a short, dense, waterproof, velvety pile. The eyes are large, round and prominent, the antennae are short, and the legs are long and slender.

Members of this family live on the waters of streams and ponds. They glide over the water, borne upon the surface tension that acts like a membrance to support the insect. Water striders are predaceous on a wide variety of organisms. Of the 22 known species in North America, seven have been found in the Park.

Family Notonectidae (back swimmers)

Back swimmers are small to medium sized bugs that swim on their backs. The body is triangular in outline and the back forms a boat-shaped keel. The eyes are large and kidney-shaped and the antennae are partly concealed between the head and the thorax. The back legs are flattened and fringed with stiff hair and propel the bug through the water. The species are carnivorous and feed on other insects. They have been reported to be very troublesome in fish hatchery tanks. They can inflict a painful jab if not handled carefully. About 50 species occur in North America; approximately 12 species are expected to occur in the Park.

Family Corixidae (water boatmen)

Corixids are flat, oval, grey or brown water bugs that are small to medium in size. The front legs bear a fringe of spines for scooping up food. The adults can fly considerable distances and are frequently attracted to lights in July and August. The species are mostly phytophagous. Twenty-two species are expected to occur in the Park.

These bugs are so abundant that they form an important part of the complex food chain of many ponds and lakes.

Order Thysanoptera (thrips)

by R.G. Foottit

Thrips are small, narrow-bodied insects which may have narrow, membranous wings. On the basis of mouthpart characteristics in particular, they are considered to be most closely related to the Psocoptera and to the Hemiptera and Homoptera. Thrips are widespread throughout the world but the greatest diversity is found in the tropics. Approximately 120 species have been recorded from Canada. While thrips range in size from 0.5 - 14.0 mm in length, the common temperate species usually do not exceed 1.0 - 2.0 mm. Thrips are found in a wide range of habitats, including forest, grassland and desert. Some species are pests on cultivated crops including those in greenhouses. There are two suborders of Thysanoptera. Many species in the suborder Tubulifera feed upon saprophytic fungal spores; these thrips are often found under the bark of dead or dying woody plants or in leaf litter and sod. Some species of thrips feed on plant sap and some are predators of smaller, soft-bodied Arthropods. Many species in the family Thripidae (suborder Terebrantia) feed on pollen.

Eight species of thrips were found in the Park. It is estimated that, in total, 15 to 20 species are present there. The most noticeable species are the flower thrips (*Frankliniella* sp., *Thrips* sp.) commonly found on the flower heads of Ox-eye Daisy (*Chrysanthemum leucanthemum*) but also seen on species of Goldenrod (*Solidago* sp.) and occasionally on such plants as Evening Primrose (*Oenothera biennis*), Joe Pye Weed (*Eupatorium maculatum*) and the saprophyte, Indian Pipe (*Monotropa uniflora*). Grass-feeding thrips (*Chirothrips* sp., *Haplothrips* sp.) were common throughout the Park, particularly in the grassland flood-plains of the Cheticamp River and in the vicinity of Ingonish. The Barley Thrips (*Limothrips denticornis* Haliday), a pest species common in the northeastern United States, was found in the Park on a number of grasses.

Order Megaloptera (alderflies, dobsonflies or fishflies)

by J.E.H. Martin

The members of this order are aquatic in habit and, while the adults may be abundant in some places, they are rarely met with in great numbers. Their chief economic significance is that both the larval and adult forms provide food for many of the fresh-water fish. The adults also serve as models for artificial flies used by fishermen, and the larvae of the Dobson-fly *Corydalis cornutus* (Linnaeus), sometimes called hellgrammites, are much sought after by anglers for bait. Although the adults of these insects do not feed and are short lived, the larvae are active predators, feeding on a variety of other insect larvae, worms, etc. The alderflies are diurnal, being most active at midday while some species of dobsonflies are attracted to light. Adults occur during early summer and are feeble fliers, usually being found on foliage, bridges, etc. near water. The order is comprised of two families, Sialidae, alderflies and Coryalidae, dobsonflies or fishflies, both of which occur in the Park.

Nigronia servicornis (Say) and *Sialis* sp. were collected during the survey.

Corydalus cornutus (L.) and *Chauliodes* sp. probably occur in the Park.

Order Neuroptera (lacewings)

by J.E.H. Martin

This small order is comprised of some 14 families with close affinities to the Megaloptera. All are terrestrial except for the small family *Sisyridae*, the spongillaflies which are aquatic and whose larvae are associated with freshwater sponges on which they feed. The Chrysopidae, the green lacewings and the Hemerobiidae, the brown lacewings are the best known families of this group. Their larvae are voracious predators feeding on almost any small insect or arachnid they are able to seize with their pincer-like jaws. They are known predators of aphids, scale insects, mites, etc. and mass rearing of some species of green lacewings for release as a biological control agent has been under study.

Suborder Coniopterygodea
Superfamily Coniopterygoidea

The Coniopterygidae (dustywings) probably occur in the Park.

Suborder Myrmeleontodea
Superfamily Mantispoidea

The family Sisyridae (spongillaflies) probably occur in the Park.

Superfamily Hemerbioidea

Family Hemerobiidae (brown lacewings)

There are twenty-three species recorded from Canada; although only three have been recorded from the Park, several more probably occur there. Adults are active from May to September and can be found in open wooded areas. They are not as common as green lacewings.

Family Chrysopidae (green lacewings)

The chrysopids are the best known of the Neuroptera. Most are green in color with golden or copper-colored eyes. They are commonly found on foliage of plants, trees, and shrubs and are readily attracted to light. Numbers can often be found at porch lights or lighted windows on warm summer evenings. Some 25 species occur in Canada. *Chrysopa oculata* Say (goldeneye lacewing) and *Chrysopa carnea* Stephen (common green lacewing) were collected during the survey, and other species probably occur in the Park.

Order Coleoptera

by J.M. Campbell, with assistance from
Y. Bousquet, D.E. Bright, L. LeSage and A. Smetana

Introduction

The order Coleoptera (beetles) is by far the largest and most diverse order of insects in the world. The estimated number of described species ranges from 250,000 to 400,000. However, most authorities agree that considerably less than half of the species have been described. Various estimates range from 1 million to perhaps 12 million different kinds of beetles in the world. Beetles are predominantly a tropical order and the diversity cited above diminishes markedly in Canada. Campbell *et al.* (1979) estimated that between 9,000 and 10,000 different species occur in Canada of which approximately 6,750 species have actually been recorded. Of the 170 known families, 106 occur in Canada (62%) and 78 (46%) are thought to occur in Cape Breton Highlands N.P. (see Table 1).

Like all insects having a complete metamorphosis, beetles have four distinct stages of development; egg, larva, pupa and adult. Most species of beetles complete their development in one year; however, some may have several generations each year while others may require many years to complete one generation (e.g. many wood-boring, long-horned beetles). Both larvae and adults may be destructive or beneficial, depending on the species. The species may overwinter in any of the life stages, but most frequently either as larvae or as adults.

Beetles have a great diversity of feeding habits. Species of many families are primarily phytophagous and often are serious pests of plants. Both larvae and adults of Chrysomelinae (leaf beetles) are external feeders on a wide variety of trees, shrubs and herbaceous plants while larvae of many species of weevils (Curculionidae) and flea beetles (Chrysomelidae) feed on roots, or are leaf miners, and those of Buprestidae (jewel beetles) and Cerambycidae (long-horned beetles) bore into wood. Both larvae and adults of many species of Staphylinidae (rove beetles), Ciidae (minute tree-fungus beetles), Leiodidae (round fungus beetles) and some Tenebrionidae (darkling beetles) feed on a wide variety of fungi. Some families are primarily terrestrial predators such as the Carabidae (ground beetles) and Staphylinidae (rove beetles) or aquatic predators (Dytiscidae, predaceous diving beetles). Other families may be carrion feeders (Silphidae, carrion beetles); dung feeders (some Scarabaeidae, scarab beetles); scavengers (some Hydrophilidae, water scavenger beetles); or pollen feeders (e.g., some adult Cerambycidae, Chrysomelidae, Mordellidae (tumbling flower beetles) or Staphylinidae).

Larvae and adults of both phytophagous and predaceous species may have similar feeding habits with both stages feeding on the same host (many Chrysomelidae and Staphylinidae), or adults may not feed or feed only on a sugar source (many Cerambycidae, Buprestidae) or adults may have strikingly different feeding habits from those of the larvae (*e.g.* larvae of

Phyllophaga (June beetles) feed on grass roots while adults feed on the foliage of trees and shrubs; adults of blister beetles feed on larvae of wild bees or grasshopper eggs, but the adults may be economically important leaf-feeding pests of cultivated and wild plants). The word Coleoptera is derived from the Greek words *coleos* meaning sheath and *ptera* meaning wings. This refers to the most distinguishing feature of beetles, the front wings (called elytra) which are hardened and sheath-like and folded back over the abdomen and usually meet in a straight line down the middle of the back. The hind or flight wings are folded under the elytra for protection. In addition, beetles have chewing type mouthparts with the mandibles well-developed, and the antennae are typically 11-segmented, though this number may be reduced in a few species. The prothorax is enlarged, distinctly separate from the remaining sections of the thorax, and covered by a dorsal shield (pronotum).

Beetles are of considerable economic importance. Some species are considered to be among the most destructive pests known to man, including major pests of household and stored products. They attack the foliage of nearly all cultivated and native plants; they bore into most species of trees; and they attack most fruit, grain, vegetable and forage crops. Of equal, or even greater significance, is their role as predators in regulating the populations of other species of insects. Some species are important as plant pollinators, promoters of decomposition of dead and waste organic matter which speeds the return of stored nutrients to the soil, and as reliable indicators of environmental changes, both in short term pollution studies and as fossils indicating long-term changes in climate during the last several million years.

As many groups of beetles are comparatively large, showy, and taxonomically well known, beetles are popular in displays and with amateurs throughout the world. From this standpoint, the most popular groups are the ground beetles (Carabidae), tiger beetles (Cicindelinae), metallic wood borers or jewel beetles (Buprestidae), scarab beetles (Scarabaeidae) and long-horned wood borers (Cerambycidae). Of all the major orders of insects, beetles are perhaps the best known taxonomically; however, as shown in Table 1, there are many species in Canada that have either never been described or discovered in the country, or that belong to groups that have never been adequately studied.

Beetles were collected during the Park survey using a wide variety of techniques and traps. Most ground dwelling Coleoptera were taken by hand-picking (turning stones, logs, etc.), by sifting various types of litter and processing it in Berlese funnels or hand sorting over a white sheet, and by using pan traps or pit-fall traps; those beetles associated with plants were taken by hand picking, sweeping or by jarring the plant over a beating sheet; beetles associated with river or stream margins were collected by splashing water on the shore and collecting the beetles as they ran; beetles associated with vegetation at the edge of water in bogs or shallow lakes were collected by treading (pressing the vegetation down under water and collecting the beetles as they float up); and those associated with special habitats such as dung, carrion, mushrooms, etc. were collected in baited pit-fall traps, flight intercept traps, or by sifting the mushroom or dung and processing the residue in a Berlese funnel. Aquatic beetles were collected primarily by using an aquatic net or small kitchen strainer. Some beetles were collected at light.

Most of the species in the Park have eastern North American distribution patterns; some are restricted to the Appalachian region and reach their northern and eastern limits in the Park. The most interesting beetles discovered in the Park seem to belong to this group and are often significant range extensions of the known range of species. Many provide the first known records of species from the Maritime Provinces. This is especially true of a number of species collected in the Lone Shieling area. Some representative species with considerably extended ranges that fit this pattern include *Coryphium nigrum* Campbell, formerly known from western Quebec, *Oxyporus rufipennis* LeC., *Aphodius manitobensis* Brown, previously known from Manitoba and Ontario, *Trigonodemus striatus* Lec., previously known from extreme western Quebec, and *Lordithon appalachianus* Campbell and *L. quaesitor* Horn., previously known from the Appalachian region north to southern Quebec. A few typical, boreal transcontinental (or Holarctic) species were found in the Park including *Olophrum consimile* Gyll. and *O. rotundicolle* (C.R. Sahlberg), *Acidota crenata* Fab., *Miscodera arctica* Paykull, *Pterostichus adstrictus* Eschscholtz, and *Hydrobius fuscipes* L. Although a number of boreal species are found in the Park, the most surprising feature of the beetle fauna is the comparative scarcity of such species. Other interesting distributional patterns of species found in the Park include the seashore restricted species such as *Cercyon litoralis* Gyll. and *Cafius bistriatus* Er. Of the approximately 1,350 species of beetles expected to be found in the Park, the occurrence of 770 of these was confirmed by collecting (Table 1).

Table 1. Estimated numbers of species of Coleoptera occurring in Canada and Cape Breton Highlands National Park

	Canada	Eastern Canada	Expected to occur in Park	Recorded from from Park
Suborder ARCHOSTEMATA				
Cupedidae	3	2	0	0
Suborder ADEPHAGA				
Carabidae	900	450	175	150
Haliplidae	43	20	3	1
Dytiscidae	315	140	50	40
Noteridae	1	1	0	0
Gyrinidae	35	30	6	3
Suborder POLYPHAGA				
Superfamily Hydrophiloidea				
Hydraenidae	23	7	3	1
Hydrophilidae	215	90	35	24
Georyssidae	2	1	0	0
Superfamily Histeroidea				
Histeridae	130	65	20	5
Superfamily Staphylinoidea				
Ptiliidae	60	30	15	5
Micropeplidae	12	5	1	0
Leptinidae	4	2	2	0
Leiodidae	110	50	30	24
Scydmaenidae	40	15	10	5
Silphidae	28	16	10	5
Scaphidiidae	20	10	5	2
Staphylinidae	1975	900	250	200
Pselaphidae	100	50	12	10
Superfamily Scarabaeoidea				
Lucanidae	10	5	2	1
Scarabaeidae	220	110	40	8
Superfamily Dascilloidea				
Eucinetidae	5	4	2	1
Clambidae	6	5	2	1
Helodidae	27	20	10	8
Dascillidae	3	3	0	0
Superfamily Byrrhoidea				
Byrrhidae	36	10	5	2

Superfamily Dryopoidea				
Psephenidae	3	2	2	1
Ptilodactylidae	2	2	1	0
Heteroceridae	18	10	7	4
Limnichidae	7	5	1	0
Dryopidae	5	8	1	0
Elmidae	26	25	7	5
Superfamily Burprestoidea				
Buprestidae	220	90	33	3
Superfamily Elateroidea				
Elateridae	380	180	120	70
Throscidae	12	8	3	1
Eucnemidae	32	8	4	2
Superfamily Cantharoidea				
Lampyridae	36	15	10	4
Cantharidae	141	50	30	26
Lycidae	25	20	8	2
Superfamily Dermestoidea				
Derodontidae	7	4	1	0
Dermestidae	32	20	6	0
Superfamily Bostrichoidea				
Anobiidae	77	40	5	0
Ptinidae	20	10	8	0
Bostrichidae	23	10	2	0
Lyctidae	8	5	2	0
Superfamily Cleroidea				
Trogositidae	28	10	5	1
Cleridae	60	30	6	4
Melyridae	55	12	3	0
Superfamily Cucujoidea				
Sphindidae	5	5	3	2
Nitidulidae	120	65	20	7
Rhizophagidae	20	13	4	2
Cucujidae	45	21	5	2
Cryptophagidae	80	30	8	5
Languriidae	6	6	1	0
Erotylidae	19	13	2	0
Phalacridae	35	12	4	2
Cerylonidae	9	6	3	1
Corylophidae (= Orthoperidae)	20	10	3	1
Coccinellidae	160	65	20	9
Endomychidae	15	8	4	2

Lathridiidae	60	30	9	3
Biphyllidae	1	1	0	0
Byturidae	2	1	1	1
Mycetophagidae	18	10	1	0
Ciidae	28	20	5	1
Colydiidae	40	4	2	0
Superfamily Tenebrionoidea				
Cephaloidae	8	4	2	2
Tenebrionidae	128	50	12	4
Lagriidae	2	2	1	1
Alleculidae	43	20	2	1
Salpingidae	16	10	4	2
Pyrochroidae	11	5	3	3
Oedemeridae	20	8	1	1
Melandryidae (Incl. Tetratomidae)	67	50	10	5
Mordellidae	70	50	10	0
Rhipiphoridae	10	4	0	0
Meloidae	60	20	4	1
Anthicidae	45	25	7	1
Pedilidae	15	11	1	1
Euglenidae	10	6	0	0
Superfamily Chrysomeloidea				
Cerambycidae	380	160	60	18
Bruchidae	20	10	0	0
Chrysomelidae	500	350	40	27
Superfamily Curculionoidea				
Anthribidae	18	14	2	0
Ithyceridae	1	1	0	0
Scolytidae	222	100	35	15
Curculionidae	1000	400	100	50
TOTAL	8861	4229	1349	789

Suborder Adephaga

Family Carabidae (by Y. Bousquet)

Ground-beetles (family Carabidae) have been one of the most popular groups of beetles among Canadian students. Many of their species are fairly large (over 6-7 mm long) and diverse in form, and they occur, often abundantly, in every major terrestrial habitat. Furthermore, thanks to the work of Lindroth (1961-1969), the taxonomy of the adults as well as the habitat of the species occurring in Canada are well known.

The Carabidae represents one of the largest families of beetles with about 40,000 species described, most of which are tropical or subtropical. In temperate and boreal regions, the majority of species are terrestrial living in leaf litter and under bark of fallen trees in forests, under rocks and debris in open fields and along the edge of water, in and at the edge of marshes, bogs, swamps, etc.

In the adult stage, many species are polyphagous ingesting both animal and plant matter. However, some species are exclusively carnivorous and are sometimes specialized feeders on certain groups of arthropods, and others are phytophagous. Larvae of most species appear to be carnivorous, while a small percentage are parasitic (genera *Lebia, Brachinus, Pheropsophus*). Since they feed on many injurious insects, without, however, being able effectively to control any pests, carabids are considered as valuable natural "auxiliaries" (Thiele 1977). Members of the group do not cause any important damage to crops or stored products.

At least in temperate and boreal regions, most species of carabids appear to be univoltine, breeding either in spring and hibernating in the adult stage, or breeding in the summer-autumn period and hibernating in the larval and often also in the adult stages. Members of many species apparently live only about a year, but cases of adults living up to 5 years have been reported.

The Carabid fauna of Cape Breton Highlands National Park and surroundings includes 150 species (Table 1) representing 50% of the species known to occur in the maritimes. About 175 species, however, can be expected to occur in the Park.

Of the species found in the Park, the most interesting ones for naturalists are the members of the genus *Cicindela* and *Sphaeroderus* and those of *Calosoma frigidum*. Adults of the genus *Cicindela*, which includes 5 species in the Park (a sixth one can be expected), occur in open areas such as sand beaches and sand pits, and generally are gregarious, diurnal and fly readily when approached. They feed on various small arthropods. Their larvae live in tunnels made in the ground and wait at the top of their tunnel to catch arthropods passing nearby. Adults and larvae of the genus *Sphaeroderus*, of which 3 species are found in the Park, live in leaf litter and under logs in forests; they feed primarily on snails and slugs. *Calosoma frigidum* is a large beetle (17-27 mm) living in forests, and specialized, as the other members of the genus, in feeding upon larvae and pupae of Lepidoptera. Adults of *C. frigidum* often climb trees in search of their prey; their larvae live exclusively on the ground.

Within the Park, most species of Carabidae occur in 6 major types of habitats, namely (the most common and interesting species are listed after): on sand beaches (*Cicindela repanda, C. duodecimguttata, C. hirticollis, C. tranquebarica, Omophron americanum, O. tesselatum, Dyschirius sphaericollis*); in forests, in leaf litter (*Sphaeroderus canadensis, S. lecontei, S. nitidicollis brevoorti, Trechus crassiscapus, T. apicalis, P. adstrictus, P. coracinus, Calathus ingratus, Synuchus impunctatus, Agonum retractum*) and under bark of fallen trees (*Pterostichus adoxus, P. tristis, Agonum decentis*); along river banks among gravel (*Diplous rugicollis, Bembidion chalceum, B. planatum, B. rusticum, B. carolinense, B. nigrum, B. salebratum, B. transversale, Elaphropus tripunctatus, Platynus tenuicolle, Apristus subsulcatus*); in and around marshes and swamps (*Bembidion incrematum, B. concretum, Pterostichus luctuosus, P. patruelis, Agonum thoreyi, A. lutulentum, A. harrisi, A. propinquum, Bradycellus nigrinus, Stenolophus fuliginosus*); in bogs (*Agonum mutatum, Bembidion quadratulum*): in open places, such as fields and road sides (*Notiophilus aquaticus, Pterostichus lucublandus, Agonum muelleri, Amara aulica, A. laevipennis, Harpalus rufipes, H. affinis, Stenolophus conjunctus, Cymindis cribricollis*).

None of the species of Carabidae occurring in the Park can be considered as rare, endangered, endemic or relict. Many of the species are boreal or temperate transcontinental (or reaching the Rocky Mountains) elements while others are typical eastern or appalachian elements reaching their northern limits within Cape Breton. Fourteen species collected in the Park have been accidentally introduced into North America by man; one of these, Stomis pumicatus, is known on this continent from only one specimen collected in the Park.

Fig. 2. Bembidion levettei Casey: a typical riverbank carabid beetle.

Table 2. List of species of Carabidae from Cape Breton Highlands National Park and surroundings [1,2]

Cicindela repanda Dejean
C. duodecimguttata Dejean
C. hirticollis Say
C. longilabris Say
C. tranquebarica Herbst

Omophron americanum Dejean
O. tesselatum Say

Scaphinotus bilobus Say

Sphaeroderus canadensis Chaudoir
S. lecontei Dejean
S. nitidicollis brevoorti LeConte

Carabus serratus Say

Calosoma frigidum Kirby

**Notiophilus aquaticus* Linné
N. semistriatus Say

Blethisa quadricollis Haldeman
B. multipunctata Linné
B. julii LeConte

**Elaphrus clairvillei* Kirby
**E. olivaceus* LeConte
**E. americanus* Dejean

Loricera pilicornis Fabricius

**Dyschirius sphaericollis* Say
**D. integer* LeConte
**D. globulosus* Say

!*Clivina fossor* Linné

**Miscodera arctica* Paykull

Patrobus longicornis Say

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[1]Within a radius of about 20 Km around the Park.

[2]An * preceding the name of a species means that the species is recorded here for the first time from Cape Breton. An ! means that the species is introduced into North America.

Diplous rugicollis Randall

*!_Trechus rubens_ Fabricius
*_T. apicalis_ Motschulsky
*_T. crassiscapus_ Lindroth

Bembidion inaequale Say
B. levettei Casey
B. chalceum Dejean
*!_B. properans_ Stephens
*_B. occultator_ Notman
B. planatum LeConte
B. rusticum Casey
B. carolinense Casey
B. nigrum Say
B. salebratum LeConte
*_B. quadratulum_ Notman
*_B. grapei_ Gyllenhal
*!_B. stephensi_ Crotch
!_B. bruxellense_ Wesmael
B. petrosum Gebler
B. sejunctum Casey
B. transversale Dejean
B. scopulinum Kirby
B. incrematum LeConte
B. immaturum Lindroth
B. patruele Dejean
*_B. contractum_ Say
B. constrictum Say
B. versicolor LeConte
B. mimus Hayward
B. muscicola Hayward
*_B. semicinctum_ Notman
B. transparens Gebler
B. concretum Casey
*_B. fortestriatum_ Motschulsky
*_B. frontale_ LeConte
*_B. wingatei_ Bland

*_Elaphropus_ incurvus Say
E. tripunctatus Say

*!_Stomis pumicatus_ Panzer

*_Pterostichus adoxus_ Say
*_P. tristis_ Dejean
P. lucublandus Say
P. adstrictus Eschscholtz
*_P. pensylvanicus_ LeConte
*_P. mutus_ Say

*!P. *melanarius* Illiger
P. *coracinus* Newman
P. *luctuosus* Dejean
*P. *tenuis* Casey
P. *leconteianus* Lutshnik
P. *patruelis* Dejean
*P. *punctatissimus* Randall

Calathus gregarius Say
*C. *ingratus* Dejean

Synuchus impunctatus Dejean

Agonum quadripunctatum DeGeer
A. *consimile* Gyllenhal
A. *sordens* Kirby
A. *retractum* LeConte
A. *gratiosum* Mannerheim
A. *thoreyi* Dejean
A. *lutulentum* LeConte
A. *canadense* Goulet
A. *cupripenne* Say
!A. *muelleri* Herbst
A. *melanarium* Dejean
A. *mutatum* Gemminger & Harold
A. *affine* Kirby
A. *metallescens* LeConte
A. *harrisi* LeConte
A. *tenue* LeConte
*A. *propinquum* Gemminger & Harold
A. *placidum* Say
*A. *extensicolle* Say
*A. *puncticeps* Casey

**Platynus mannerheimi* Dejean
P. *decentis* Say
P. *tenuicolle* LeConte

**Disamara arenaria* LeConte

!*Amara aulica* Panzer
*A. *quenseli* Schonherr
*A. *discors* Kirby
!A. *bifrons* Gyllenhal
*A. *laevipennis* Kirby
*A. *impuncticollis* Say
!A. *familiaris* Duftschmid
!A. aenea DeGeer

!*Harpalus rufipes* Degeer
!*H. affinis* Schrank
**H. laticeps* LeConte
**H. egregius* Casey
**H. fulvilabris* Mannerheim
H. pleuriticus Kirby
H. fallax LeConte
H. plenalis Casey

**Anisodactylus nigerrimus* Dejean
A. kirbyi Lindroth

**Trichocellus cognatus* Gyllenhal

Bradycellus lecontei Csiki
B. rupestris Say
B. nigrinus Dejean
**B. lugubris* LeConte
B. neglectus LeConte

Stenolophus fuliginosus Dejean
**S. ochropezus* Say
S. conjunctus Say

Acupalpus carus LeConte
A. canadensis Casey
**A. pauperculus* Dejean

**Diplocheila obtusa* LeConte

Badister neopulchellus Lindroth
**B. obtusus* LeConte
B. grandiceps Casey

Chlaenius sericeus Forster
C. lithophilus Say
C. niger Randall

**Lebia viridis* Say

**Dromius piceus* Dejean

Agristus subsulcatus Dejean
A. latens LeConte

Metabletus americanus Dejean

Cymindis cribricollis Dejean

In addition to the terrestrial beetles, the Suborder Adephaga contains three families of aquatic beetles in the Park. The family Haliplidae (crawling water beetles) resemble the family Dytiscidae, but can be readily distinguished by the presence of large, plate-like hind coxae. Most adults are poor swimmers, unlike those of the family Dytiscidae, and are usually found in shallow standing water crawling around on submerged vegetation. Adults feed primarily as scavengers on decaying vegetation and algae while larvae are either scavengers or predators of other aquatic arthropods. Of the three species that could occur in the Park, only *Haliplus immaculicollis* Harris was found.

Adults of the family Gyrinidae (whirligig beetles) are often found whirling in circles on the surface of water. They can be readily distinguished by their flattened body and by having the eyes completely divided dorso-ventrally into an upper pair modified to see above water and a lower pair to see under water. Adults are scavengers feeding on material on the surface and larvae are predaceous on other aquatic arthropods. Of the six species expected to occur in the Park, *Gyrinus impressicollis* Kirby and *G. aquiris* LeConte were the most abundant.

The family Dytisicidae was well represented and collected in the Park with 40 of the 50 expected species taken. This is a major component of the freshwater insect fauna in relatively quiet water. Both adults and larvae of all species are predators, usually on other aquatic arthropods. However, the species of the genus *Dytiscus* may also feed on tadpoles and small fish. Most of the species taken in the Park are widely distributed in northeastern North America, and many are transcontinental. The occurrence of *Hydroporus aequus* Fall from the Park is a new record for Nova Scotia. Many of the dytiscids collected in the Park are quite small (e.g. *Liodessus fuscatus* (Crotch)) but they range in size up to the large species *Graphoderus perplexus* Sharp.

Suborder Polyphaga

Superfamily Hydrophiloidea

This superfamily contains two families in the Park, the Hydraenidae (minute moss beetles) and the Hydrophilidae (water scavenger beetles). Species of Hydraenidae are small (usually about 1.5 mm long) and the adults cannot swim, but cling to submerged rocks or dead wood or crawl about on gravel and debris. Larvae are mostly semiaquatic or terrestrial predators. One species, *Ochthebius kaszabi* Jansson which was found in the Park, is widely distributed throughout Canada.

Family Hydrophilidae (by A. Smetana)

The Hydrophilidae (water scavenger beetles) is a large family of mostly aquatic beetles consisting of about 1700 species in the world fauna. About 215 species of this family are known to occur in Canada.

Hydrophilids vary in length from 1.5 to over 40 mm, but most of them are small to fairly large beetles not exceeding the length of 10 mm. They differ from all other aquatic beetles that may resemble them in general habitus, by having the first abdominal segment undivided and the antennae clubbed. Unlike the Dytiscidae, most hydrophilids are poor swimmers. Respiration in the aquatic species is from a bubble held on the underside of the body by specialized hydrofuge hairs, and periodically renewed during visits to the surface by use of the specialized antennal club.

Most hydrophilids prefer lentic aquatic habitats, such as shallow standing water among vegetation and bottom debris of edges of shallow lakes, ponds, road-side ditches, etc., whereas some occur in muddy edges or even in semiaquatic habitats, such as soaking-wet moss in swamps and bogs. Members of the subfamily Sphaeridiinae are found in terrestrial habitats associated with all kinds of decaying organic matter, such as rotting plant debris or animal droppings.

In the adult stage, most species are scavengers feeding on rotting leaves or vegetation, on algae, etc., but some members of the subfamily Sphaeridiinae are predators. Larvae of almost all hydrophilids are predators.

The hydrophilid fauna of Cape Breton Highlands National Park is relatively poor. It includes only 24 species, representing about 27% of the species known to occur in eastern Canada; however, some 10 additional species can be expected to occur in the Park.

Within the Park, the hydrophilids occur in the following main habitats:

1) Shallow standing water with plenty of organic debris and plentiful vegetation, such as edges of lakes, ponds, ditches and swamps (*Berosus peregrinus, Laccobius agilis, Hydrobius fuscipes, Paracymus subcupreus, Crenitis digesta, C. monticola, Anacaena limbata, Enochrus hamiltoni, E. ochraceus, Cymbiodyta vindicata*).

2) Temporary or permanent, shallow muddy ponds and puddles with decaying plant debris (*Helophorus grandis, H. sempervarians, H. lacustris, H. angusticollis, Anacaena limbata*).

3) Bogs (*Cymbiodyta vindicata, C. acuminata*).

4) Salt marshes (*Anacaena limbata, Enochrus hamiltoni*).

5) Seashore wrack (*Cercyon litoralis*).

6) Terrestrial species occurring in decaying organic matter, such as animal droppings (*Sphaeridium bipustulatum, Cercyon assecla. C. haemorrhoidalis*).

Most of the species occurring in the Park are widely distributed, at least in northeastern North America, or are even transcontinental. A large number of species were recorded for the first time from Nova Scotia; four species were introduced to North America by man (see the list of species).

Table 3. List of species of Hydrophilidae from Cape Breton Highlands National Park [1]

Hydrochus squamifer Say

+*Helophorus grandis* Illiger
**H. sempervarians* Angus
H. lacustris LeConte
H. angusticollis d'Orchymont

Berosus peregrinus Herbst

Laccobius agilis Randall

Hydrobius fuscipes Linné
**H. melaenus* Germar

Paracymus subcupreus Say

Crenitis digesta LeConte
**C. monticola* Horn

Anacaena limbata Fabricius

**Enochrus perplexus* LeConte
E. ochraceus Melsheimer
E. hamiltoni Horn

Cymbiodyta vindicata Fall
**C. acuminata* Fall

+**Sphaeridium bipustulatum* Fabricius

**Cercyon praetextatus* Say
**C. assecla* Smetana
+*C. lateralis* Marsham
+*C. haemorrhoidalis* Fabricius
C. litoralis Gyllenhal

An * in front of the name = first record from Nova Scotia
An + in front of the name = introduced species.

Superfamily Histeroidea

This superfamily contains only one family, Histeridae (hister beetles), in eastern Canada. Species of this family are usually predaceous, both as larvae and as adults. Most species are found in carrion, dung, in piles of decaying organic matter and under bark, where they prey primarily on fly larvae. Only five species were taken in the Park, though as many as 20 species were expected to be found there. The most common species was *Margarinotus foedatus* (LeC.) which was the first record of the species from Nova Scotia. Also of interest was *Baeckmanniolus palmatus* (Say) which was associated with the wrack on the seashore and *Plegaderus transversus* (Say) which was found in the galleries of the bark beetle *Ips grandicollis*.

Superfamily Staphylinoidea

This superfamily consists of nine families in the Park and contains the greatest diversity of species of any superfamily of beetles. However, since most of the species of these families are small in size and many belong to genera or families that have never been adequately studied or collected in Canada, many of the species could not be identified.

The family Ptiliidae (feather-winged beetles) are among the smallest beetles known, often less than 1 mm long. Only about 30 species are thought to occur in eastern Canada, but it is not possible at this time to identify them to species. These beetles are common in leaf litter, tree holes, moss and similar habitats and are most frequently collected from samples processed in Berlese funnels. It is estimated that five species were found in the Park, but none was identified.

The family Micropeplidae (micropeplid beetles) were not collected in the Park, but one species *Micropeplus laticollis* Maklin should occur.

The family Leptinidae (mammal nest beetles) also were not collected in the Park. Two species, *Platypsyllus castoris* (Ritsema) and *Leptinillus validus* (Horn), are associated with beavers and beaver houses. Although they were not taken, they almost certainly do, or have, occurred in the Park at times when beavers were more abundant. The biology of these species was studied by Wood (1964).

The family Leiodidae (round fungus beetles) feed primarily on various fungi and slime molds, but some species are scavengers, living in decaying plant and animal matter. This was one of the more abundant families of beetles taken in the flight intercept traps. Nine species were identified for the first time for Nova Scotia, these are: *Anisotoma geminata* Horn, *A. basilis* (LeC.), *A. discolor* (Melsh.), *A. horni* Wheeler, *A. glaburosa* Hatch (?), *Catops simplex* (Say), *C. americanus* Hatch, *C. gratiosus* (Blanch.), and *Prionochaeta opaca* (Say). Approximately 24 species in 8 genera seem to be present in the material at hand.

The family Scydmaenidae (ant-like stone beetles) is a family of small beetles usually found in rotting wood, in leaf litter, in moss, in tree holes, or under bark. Five species were taken in the Park, but another four or five species are likely to occur. The only species identified was *Euconnus clavipes* (Say); this is the first record of this species east of Quebec.

The family Silphidae (carrion beetles) are large, colorful beetles usually found on dead carcasses. The family is well known taxonomically (Anderson and Peck, 1985) and easily collected by the use of baited pitfall traps. Of the 16 species known from eastern Canada, only five were taken in the Park, though another five might be expected to occur there. The most abundant species was *Nicrophorus defodiens*, Mann. but *N. sayi* Lap., *N. vespilloides* Hbst., *N. investigator* Zett., and *Oiceoptoma noveboracense* (Forster) were also taken. The combination of their large size and frequent coloration of orange and black, plus their association with dead carcases often contribute to their being brought to the attention of Park naturalists. Both larvae and adults feed on carrion, the adults usually burying the carrion and placing eggs on it so that the hatching larvae will have food.

The family Scaphidiidae (shining fungus beetles) is not well-represented in the Park, with only two species being collected. These beetles live in fungi, rotten wood, dead leaves and under bark. Two unidentified species of the genus *Baeocera* were relatively abundant in the North Mountain and Lone Shieling areas on fungi found on tree stumps.

The family Staphylinidae (rove beetles) is the largest family of beetles found in the Park. Approximately 200 species were collected in the Park, though many of these are representatives of genera in which species identification is impossible. The diversity of this family is surprisingly large when compared with the relatively depauperate representation of species of other families of beetles in the Park. This can probably be attributed to the efficiency of some of the traps utilized in the Park survey. There were more interesting new record finds of rare species and range extensions of rare beetles than for any other family of beetles, possibly because of the relative lack of information for many genera of rove beetles.

This is the largest family of beetles found in Canada, with an estimated 1,900 species. The 200 species found in the Park (11.6% of the estimated Canadian fauna) were found in a wide variety of habitats. One habitat in the Park having a surprisingly large diversity of rove beetles was fleshy mushrooms. The feeding habits of the beetles found in this habitat vary from predaceous (usually feeding on fly larvae) like the species of *Tachinus, Lordithon* and *Philonthus cyanipennis* Fab., to feeding on the mushrooms, such as the species of *Oxyporus*, or spore feeding, like the species of the genus *Gyrophaena*. A partial list of the rove beetles associated with mushrooms is shown in Table 4.

Table 4. List of species of Staphylinidae associated with mushrooms in Cape Breton Highlands National Park.

Acidota subcarinata Er.

Arpedium cribratum Fvl.

Creophilus maxillosus L.

* *Megarthrus americanus* Sachse
Megarthrus sp.

Proteinus sp. (2 spp.)

Staphylinus capitatus Bland.

Tachinus addendus (Horn)
T. basalis Er.
* *T. fimbriatus* Grav.
T. frigidus Er.
T. fumipennis Say
T. luridus Er.
* *T. memnonius* Grav.
* *T. picipes* Er.
* *T. quebecensis* Robert

* *Lordithon appalachianus* Campb.
* *L. bimaculatus* (Couper)
* *L. facilis* (Csy.)
* *L. fungicola* Campbell
* *L. longiceps* (LeC.)
* *L. obsoletus* (Say)
* *L. quaesitor* (Horn)
* *L. scutellaris* Campbell
* *L. thoracicus* (Melsh.)

* *Oxyporus lateralis* (Grav.)
* *O. quinquemaculatus* LeC.
* *O. rufipennis* LeC.
* *O. vittatus* Grav.

Philonthus cyanipennis (Fab.)
Philonthus blandus Grav.

* *Trigonodemus striatus* LeC.

* *Gyrophaena* spp.

* restricted to mushrooms

Other habitats in which rove beetles were numerous include: wrack on the seashore (*Cafius bistriatus* Er. and *Aleochara* sp.), in flowers feeding on pollen (3 species of *Eusphalerum*), in gravel along streams (*Psephidonus strictus* Fvl., *Microedus austinianus* LeC.), under bark (*Siagonium punctatum* LeConte and *Charhyphus picipennis* (LeC.)), in moss along waterfalls (*Brathinus nitidus* LeC.), burying in sand (3 species of *Bledius*), in carrion (*Creophilus maxillosus* L.), in dung (*Oxytelus fuscipennis* Mann.), and in bogs, lake margins and similar semiaquatic habitats (particularly many species of *Stenus, Lathrobium* and *Euaesthetus*), in beaver lodges (*Rugilus angustatus* Fourc.) and in various kinds of leaf litter (*Arpedium cribratum* Fauv. and *Lesteva pallipes* LeC. were particularly abundant in wet moss and alder litter).

Some of the rarer species collected or more interesting range extensions in the Park include: *Coryphium nigrum* Campb. (originally known in Canada from one specimen from western Quebec), *Pelecomalium laevicolle* (an Appalachian species not previously known from the Maritime Provinces), *Pycnoglypta aptera* Campb. (a species described from Kouchibouguac N.P., and previously unknown from Nova Scotia), *Trigonodemus striatus* LeC. (a species previously unknown from east of western Quebec), *Tachinus schwarzi* Horn (an Appalachian species previously known in Canada from only two Quebec specimens), *T. horni* Campb. (an Appalachian species previously known in Canada only from one specimen collected from Mt. Tremblant in Quebec), *Lordithon longiceps* LeC. (a transcontinental, boreal species unknown from east of Quebec City), *Lordithon quaesitor* (an Appalachian species previously unknown from east of Quebec and known from only two localities in Canada) and *Staphylinus capitatus* Blanch. (previously unknown from Nova Scotia).

The most conspicuous or abundant species of rove beetles in the Park include *Philonthus cyanipennis* Fab. which may be readily identified by its bright blue-green elytra, *Creophilus maxillosus* L., the largest rove beetle in the Park and usually found on carrion, *Ontholestes cingulatus* L. another large species found on carrion or decaying vegetation, and four species of *Oxyporus* found in mushrooms and identified by their orange and black color, elongate mandibles and enlarged maxillary palpi. Some genera are almost ubiquitous in the Park, at least one or more of the 25 species of *Stenus* and 13 species of *Lathrobium* are found in almost every moist habitat in the Park, including wet leaf litter, wet moss, edges of ponds, bogs, marshes, and on gravel margins of streams and rivers, near water.

The family Pselaphidae (short-winged mold beetles) is a diverse family most species of which are found in tropical regions. The Canadian species are poorly known taxonomically and have never been revised. An estimated 40-50 species occur in eastern Canada, but only 10 species were collected in the Park. Species of this family are found in leaf litter, under bark, in moss, and in rotting logs or tree holes, and in wet vegetation around ponds, marshes and moss. Both adults and larvae are predators and a few species are associated with ants. Of the ten species collected, none had been recorded previously from Nova Scotia, though most of them had been taken in either Kouchibouguac National Park, New Brunswick or Quebec. The most abundant species in the Park are *Pselaphus bellax* Csy. taken in moist birch litter, and *Rybaxis mystica* Csy. taken by treading vegetation at the edge of ponds and marshes.

Superfamily Scarabaeoidea

This superfamily contains two families in the Park, the Lucanidae (stag beetles) and the Scarabaeidae (scarab beetles). Of the two species of stag beetles expected in the Park, only *Platycerus virescens* F. (a new record for Nova Scotia) was collected. Stag beetles are similar in most respects to scarab beetles, but may be readily distinguished by their inability to close the clubbed, terminal antennal segments. The larvae are found in dead wood, and the adults feed on honeydew or on exudations of the leaves and bark of trees.

The scarab beetles are a large family of beetles in Canada (over 200 species) which seem to be depauperate in the Park with only 8 species collected. The reasons why such a small number of species were collected may have been the collecting methods used, but in previous surveys the flight intercept traps used in the Park study have proven to be efficient in trapping scarabs. Therefore, the low number of species taken probably reflects a truly depauperate fauna. Species of this family are often of considerable economic importance. Adults of June beetles feed on the leaves of a variety of trees, whereas their larvae are serious pests of the roots of grass, particularly in yards and golf greens. Adults of other species may feed on pollen, sap flows, fungus, dung, and rotting wood or animal skins. The most interesting discovery for this family was *Aphodius manitobensis* Brown, which was collected from deer dung and is the first record of the species from east of Ontario. *Osmoderma scabra* Beauv. is a large beetle whose larvae bore into rotting wood. This species is one of the largest beetles (or insects) found in the Park.

Superfamily Dascilloidea

This superfamily contains four families in Canada of which only three are found in the Park. The taxonomy of these families is poorly known and the species distribution in Canada is largely unknown.

The family Eucinetidae (plate-thigh beetles) are usually collected under bark. The habits of the larvae are unknown. One unidentified species of the genus *Eucinetus* was taken in the Park.

The family Clambidae (minute beetles) are small (usually 1-2 mm) and are associated with rotting plant material. One unidentified species was taken in the Park.

The family Helodidae (marsh beetles) is usually associated with wet habitats at the edge of bogs, marshes, and shallow lakes. The larvae are aquatic in streams, ponds, stagnant pools, etc. Of the eight species taken in the Park, *Cyphon obscurus* Guer. and *C. variabilis* Thun. were both extremely abundant. *Prionocyphon discoideus* Say was taken at Lone Shieling and was previously unknown from the Maritime Provinces.

Superfamily Byrrhoidea

This superfamily contains only one family, the Byrrhidae (pill beetles). Both larvae and adults of this family are plant feeders usually found on decaying leaves in litter. Most species have northern distributions, including both of the species collected in the Park, *Byrrhus americanus* LeC. and *B. kirbyi* LeC.

Superfamily Dryopoidea

by L. LeSage

This superfamily contains six families in Canada, though only the Psephenidae, Heteroceridae and Elmidae have species in the Park.

Adults of the family Psephenidae (water-penny beetles) are found at margins of streams and rivers. Larvae, commonly called "water pennies", are well known and easily recognized by their unusually flat and oval shape, which is an adaptation to their mode of life on the underside of stones in fast-flowing waters.

The family Heteroceridae (variegated mud-loving beetles) are easily recognized by the flattened mandibles and the coarse comb of flattened spines on the outer margin of the fore and middle tibiae, which are an adaptation to life in galleries in muddy banks of streams and rivers. Adults are good fliers and are often attracted to lights in large numbers. The larvae live in the same habitat as the adults and have a distinctive shape, widest at the thorax and tapering posteriorly. This family is reasonably well known taxonomically because of the revision of Pacheco (1964). Adults may be easily collected by splashing water on mud banks.

Adults of the family Elmidae (riffle beetles) are fairly abundant in streams and rivers in the Park, but only five species were collected. *Promoresia tardella* (Fall) was abundant and widely distributed in the Park, usually concentrated in areas covered by aquatic mosses. *Oulimnius latiusculus* (LeC.) was usually found in acid, brown water like that of Fishing Cove River. *Optioservus ovalis* (LeC.) was much less abundant and specimens were found in only 10 creeks and rivers, usually concentrated in gravel beds such as found in Still Brook and a small, unnamed creek near the Cheticamp entrance to the Park. *Dubiraphia quadrinotata* (Say) was found only in a small, unnamed lake near the Cheticamp entrance to the Park. This species usually colonizes margins of lakes and slow moving rivers or slow reaches in streams. *Stenelmis crenata* (Say), a common and widespread species of running waters in eastern Canada, was found only in a small creek at Warren Lake.

Superfamily Buprestoidea

This superfamily contains only one family, the Buprestidae (jewelled beetles, metallic wood-borers, flat-headed wood borers). The larvae (flatheaded wood-borers) bore into the tissues of woody and herbaceous plants. The adults (metallic wood-borers) are most easily collected by rearing from infested trees and shrubs and, although they are often rather large and showy, they are rarely seen or collected. As there was no active rearing program undertaken in the Park, the low diversity of only 3 species collected is probably a collecting artifact. One species, *Melanophila drummondi* Kirby, widely distributed in eastern Canada, was abundant in the Park. Some species of this family can be extremely destructive to forests. The bronze birch borer has killed extensive stands of birch in Quebec and other areas in eastern Canada. In addition, a number of other species of the family are potentially serious pests.

Superfamily Elateroidea

The family Elateridae (click beetles or wireworms) are common in the Park. Click beetles are a large, diverse family easily recognized by their ability to snap into the air several inches when disturbed. Adults are found in a variety of habitats, usually crawling on the lower vegetation in the late afternoon and early evenings during June or sunning by sitting at the tops of herbaceous plants on warm, still days. Other species are found under bark, in leaf litter, and under stones. Larvae (wireworms) are found in rotting wood, leaf litter, or in the soil. Most species are predaceous, but some are phytophagous and may be potential pests of some plants in the Park. Species of this family may require 1 to 3 years to complete their development.

The family Throscidae (pseudoclick beetles) are small brownish beetles that more closely resemble buprestids than click beetles. However, these beetles have a functional "click mechanism" (prosternal spine and mesosternal cavity). Like the elaterids, they are found crawling on lower vegetation in June, but little is known about the larval stages.

The family Eucnemidae (false click beetles) also have a "clicking mechanism", but differ from the Elateridae and the Throscidae by having the labrum concealed and the antennae more distant from the eyes. Adults are usually found crawling on lower vegetation in the late afternoon on still days in June. The larval stage of one species is associated with rotting wood, particularly beech.

Superfamily Cantharoidea

There are three families of Cantharoidea in the Park, most of which are reasonably well known taxonomically. The most abundant family is the Cantharidae (soldier beetles). Adults are firefly-like, being soft bodied, but lack light producing organs and are commonly found on herbaceous plants, particularly goldenrod and milkweed where they feed on pollen and nectar. The larvae are found beneath bark and under debris and are predaceous on other insects. As adults are easily collected, it is thought that the 26 species collected in the Park probably represent almost all of the species present. Species of the genera *Cantharis* and *Malthodes* were present in large numbers.

The family Lampyridae (firefly beetles or lightningbugs) were not particularly abundant in the Park. These beetles are easily recognized by the presence of light producing organs on the apical sternites of the abdomen, by the concealed head which is covered by the broadly widened pronotum, and by the soft body. Adults are conspicuous on warm nights as they fly around blinking their lights. The sequence of blinks is a species isolating mechanism and insures that there is no cross-mating between species. Most adults do not feed, but the larvae are predaceous on land mollusks, earthworms, caterpillars, other insect larvae and occasionally other species of fireflies. Females are usually wingless and, like the larvae, also give off light at night and are referred to as "glowworms". Only four species were collected in the Park, of which *Lucidota atra* F. was collected for the first time in Nova Scotia.

The family Lycidae (net-winged beetles or lycid beetles) are also soft-bodied, are fan-shaped in apperance, have large antennae, and have the elytra veined in a characteristic "net-like" pattern of raised veins. Adults are found on foliage and tree trunks where they feed on juices of decaying plant materials. Larvae are predaceous. Only two species were found in the Park. Adults of this family are usually colored orange and black which is a warning coloration often indicating that an insect is distasteful. Lycids are frequently models mimicked by a number of long-horned beetles and a variety of moths.

Superfamily Dermestoidea

No species of this superfamily were collected in the Park, though specimens of two families, the Derodontidae (tooth-neck fungus beetles) and the Dermestidae (skin beetles) should occur there. The derodontids should be represented in the Park by *Laricobius rubidus* LeConte, a well known predator of aphids. Most of the species of skin beetles expected in the Park should be associated with man. They are frequently found feeding on stored food products, furs, leather, and wool rugs. Adults are often found on flowers, and the lack of them in the Park collections indicates that if present, they are scarce.

Superfamily Bostrichoidea

Although four families of this superfamily could be present in the Park, no representatives were collected. Of these families, the Anobiidae (death-watch beetles), Bostrichidae (powder-post beetles) and Lyctidae (lyctid powder-post beetles), are mostly wood boring. A few species of Anobiidae and the family Ptinidae (spider beetles) are associated with stored products and are spread by man or exist under natural conditions in mammal nests. Again, the lack of these beetles in the Park collections indicates that if representatives of these families do occur there, they are scarce and pose no serious problem.

Superfamily Cleroidea

Only a few species of this superfamily occur in the Park. One species of the family Trogositidae (bark-gnawing beetles), *Tenebroides mauritanicus* (L.) (the "cadelle"), was found in the Park. This species is a common granary pest. Four species of the family Cleridae (checkered beetles) were found in the Park. Both larvae and adults of this family are predators of wood-boring beetles (particularly Scolytidae and Cerambycidae).

Superfamily Cucujoidea

Of the 17 families of this superfamily expected to occur in the Park, only 13 were collected. Most representatives of this superfamily are small in size, often fungus-feeding and are poorly known taxonomically, partially because of their small size and obscure habits. Nevertheless, some of the representatives, particularly the Coccinellidae, Erotylidae, and Nitidulidae are either economically important or showy and as a result, are well known taxonomically.

Of the seven species of Sphindidae (dry fungus beetles) and Rhizophagidae (root-eating beetles) expected to occur in the Park, only four were collected. Dry fungus beetles are found on shelf fungi on tree trunks and on slime molds on dead trees and logs. The occurrence of *Odontosphindus denticollis* and *Eurysphindus hirtus* in the Park are new records for Nova Scotia. Two species of the genus *Rhizophagus* were found under bark, but little is known about their feeding habits. Some species of the family are apparently predaceous on eggs and larvae of bark beetles.

The family Nitidulidae (sap beetles) are often abundant, but only a few species were taken in the Park. Both adults and larvae of this family are primarily mycetophagous or saprophagous. They are usually found in decaying fruits, fermenting plant juices, in fungi, at sap flows of trees, and in the seed capsules of plants. Some adults feed on pollen and petals of flowers. Of the 7 species of the family collected in the Park, all are widely distributed eastern species.

The family Cucujidae (flat bark beetles) are usually found under bark or in decaying plant material. Most species of the family are predaceous, at least in the larval stages, but some cosmopolitan species such as the saw-toothed grain beetle, *Oryzaephilus surinamensis* (L.), are important pests of stored products. Both of the species collected in the Park are predaceous. *Cucujus clavipes* Fab. is the largest species of the family occurring in Canada. It is quite distinctive because of its uniformly red color.

Five species of the family Cryptophagidae (silken fungus beetles) were collected in the Park, including 3 species of *Atomaria* and 1 of *Antherophagus*. Most species feed on fungi and decaying vegetation.

The families Phalacridae (shining flower beetles), Cerylonidae (cylindrical bark beetles) and Corylophidae (minute fungus beetles) are poorly represented in the Park. Phalacrids are often quite common on flowers, particularly goldenrods and other composites and grasses that have been attacked by rusts, but the family has not been adequately revised and species determinations are not possible at this time. The cerylonids are usually collected in leaf litter, under bark and in fungus. The corylophids are rarely collected because of their small size. Both adults and larvae are found in leaf litter, decaying plant material, under bark, or similar habitats with an abundant growth of fungal mycelia. Only 1 species, not identified, was collected in the Park.

The family Coccinellidae (ladybird beetles) are an important family of predaceous beetles that are widely used in biological control programs against aphids, scale insects and mites. Adults are frequently found in the spring and fall in large, overwintering aggregations. *Coccinella 7-punctata* L. is an introduced species that is quite common in the Park and *Scymnus lacustris* LeC. and *Nephus ornatus* LeC. were collected for the first time from Nova Scotia. The family contains one phytophagous species *Epilachna varivestris* Muls. a common pest of beans, but this species was not collected.

The family Endomychidae (handsome fungus beetles) is represented in the Park by *Phymaphora pulchella* and *Endomychus biguttatus*. These beetles feed on fungi and mold under bark, in rotten logs, in fungi and decayed fruit.

Species of the family Lathridiidae (minute brown scavenger beetles) are usually found associated with fungus in leaf litter, under bark, or similar habitats where fungus growth is abundant. *Stephostethus liratus* and *S. breviclavis* were both abundant in the Park.

One species of Byturidae (*Byturus unicolor* (Say), (the raspberry fruitworm) was collected in the Park. This is a widely distributed pest of the fruits and canes of raspberries and blackberries. The family Ciidae (minute tree-fungus beetles) was represented in the Park by only one species, apparently undescribed, of the genus *Ceracis*. These beetles feed on fungi under bark, in rotting wood, or, usually, in dry woody fungi.

Superfamily Tenebrionoidea

This superfamily is represented in the Park by 11 families, each with only a few species. Most adults of the species of this superfamily are moderately large in size, are frequently collected, and are usually well known taxonomically. Only four species of Tenebrionidae (with over 120 species known from Canada), one of Meloidae (60 species known from Canada), one of Mordellidae (over 60 species in Canada), one of Alleculidae (over 40 species in Canada) and one of Anthicidae (45 species known from Canada) were collected.

The family Tenebrionidae (darkling beetles) is a large family with thousands of species found in all faunal regions, but most diverse in tropical and arid regions. Some of the species found under bark are either large or bizarre in their appearance and are frequently brought to the attention of naturalists. These include a species of *Phellopsis, Bolitotherus cornutus* and *Ipthiminus opacus* LeC. All of the members of this family are protected from predation by a pair of abdominal defensive glands which give off an unpleasant odor when the beetles are disturbed.

One species of the family Alleculidae (comb-clawed bark beetles) and one of the family Lagriidae (lagriid beetles) were found in the Park. These families are often combined with the Tenebrionidae by many modern authors because they have defensive glands similar to those of the darkling beetles. The alleculid, *Isomira quadristriata* Couper, was common in the Park on low, herbaceous plants in the forest. The lagriid *Arthromacra aenea* (Say) is usually found on dead leaves on trees or under bark. Both species are widely distributed in eastern North America.

The family Cephaloidae (false longhorn beetles) are represented in the Park by *Cephaloon ungulare* and *C. lepturoides* Newm. Both species are widely distributed in eastern North America. Adults are usually found on flowers, but the habits of the larvae are unknown.

The family Pyrochroidae (fire-colored beetles) are very distinctive in appearance due to their rather large size, usually bright colors and often pectinate antennae. Larvae are carnivorous and are often common under bark. *Dendroides concolor* Newm. was abundant in the Park. A number of specimens of the two rare species *Ischalia costata* (LeC.) and *Schizotus cervicalis* Newm. were collected at Lone Shieling and MacKenzie Mountain.

The family Salpingidae (narrow-waisted bark beetles) are represented in the Park by *Priognathus monilicornis* (Rand.) and *Rhinosimus viridaeneus* Rand. Adults of these species are fairly large beetles usually found under bark of logs. Both adults and larvae are carnivorous. *Rhinosimus* is particularly interesting because of the long, weevil-like head. Both species are widely distributed in eastern North America.

The family Oedemeridae (false blister beetles) contains only one species in the Park, the wharf borer, *Nacerda melanura* L. This species is an economic pest, boring into old, wet ship timbers, dead logs, pilings under wharves and under buildings near water, causing considerable structural damage.

Five species of the family Melandryidae (false darkling beetles) were collected in the Park. One species, *Canifa pallipes* Melsh., was extremely abundant on flowers of cow parsnip, *Heracleum maximum* Bartr. A second species, *C. pallipennis* LeC., was also found on flowers, but was much less abundant than *C. pallipes*. *Penthe obliquus* (Fab.), a large, flat species that is black with a reddish scutellum, was found under bark. In addition, specimens of *Mystaxus simulator* Newm. and *Serropalpus barbatus* (Schaller) were also found.

One species each of the families Meloidae (blister beetles), Anthicidae (ant-like flower beetles), and Pedilidae (false ant-like flower beetles) were found. *Anthicus scabriceps* LeC. was found under pieces of wood and debris on the beach and a *Pedilus* sp. was found in leaf litter at Lone Shieling. The only blister beetle found in the Park was *Epicauta fabricii* (LeC.). Adults of this species are plant feeders and the larvae feed on grasshopper eggs. Larvae of this genus are particularly unusual in that they are hypermetamorphosic: the first instar larvae (triungulins) are adapted for finding grasshopper eggs: this is followed by a series of feeding instars in which the body becomes thicker and C-shaped and the legs become shorter; the sixth instar does not feed (coarctate stage), has no legs, and becomes heavily sclerotized; the seventh instar again becomes active and usually does not feed, but seeks a pupal site. Another characteristic of members of this family is their ability to produce cantharadin, a chemical secreted by the beetles when disturbed which causes blisters on contact with the skin. Some species of the genus *Epicauta* produce the chemical in sufficient quantities that, if eaten with hay, they may be lethal to horses. Although only one species was found, species of the genera *Lytta* and *Meloe* should also occur.

Superfamily Chrysomeloidea

The family Cerambycidae (longhorned beetles or round-headed wood borers) is one of the most important and destructive families of wood-boring beetles. Of the 380 species thought to occur in Canada, only 18 species were collected during the survey, though a number of other species undoubtedly occur. The most distinctive cerambycid in the Park is probably *Tragosoma depsarius* (L.), which is probably the largest beetle found in the Park. *Acmaeopsoides rufula* (Hald.), *Saperda concolor* LeC., *Neocanthocinus pusillus* (Kby.), *Hyperplatys maculata* Hald., and *Brachysomida bivittata* (Say) were collected for the first time from Nova Scotia.

Family Chrysomelidae (by L. LeSage)

The leaf beetles are a large family with over 25,000 species described for the world. About 2,000 species occur in North America, 350 in eastern Canada, but only 27 were found in the Park despite intensive collecting. Many of the species of this family are well known and of considerable economic importance, e.g., the Colorado potato beetle. The Canadian fauna is rather well known in the adult stages and new species can be expected only in the subfamilies Galerucinae, Eumolpinae and Alticinae. However, the immature stages of most species are poorly known.

Three major reasons explain the relative poverty of leaf beetles in the Park. First, leaf beetles are primarily a tropical group, and only a few elements are adapted to the northern flora and environment. Secondly, many of the boreal adapted species that might be expected to live in the Park have never become established in the region, and thirdly, many of the dominant plants of the Park (conifers, hardwoods, ferns) are poorly utilized as food by leaf beetles. Consequently, only small colonies survive here and there on other host plants, making surveys time-consuming and difficult.

The Chrysomelidae are subdivided into several subfamilies which are often given family status because of the different habitus of the adults and the different types of larvae. The subfamily Donaciinae (about 30 species) is aquatic in larval stages and pupate underwater in cocoons. The larvae possess two spine-like stylets used for respiration when these are inserted in the cellular tissue of plants. The adults, metallic and brightly colored, are appreciated by collectors. They feed on leaves of various aquatic plants. This subfamily is represented in the Park by *Plateumaris emarginata* Kirby, the commonest species, and 5 additional rare ones.

The subfamily Orsodacninae is represented in the Park by *Orsodacne atra* (Ahrens). They feed on rootlets in larval stages, and adults are attracted in the spring by blooming trees (poplar, willow, cherry, etc.) where they can be captured in large numbers.

The subfamily Cryptocephalinae is usually found in the Park on plants (Ericaceae, Rosaceae, Salicaeae, etc.) growing on acid soils. The larvae, in general, cannot climb and feed on decaying leaves of the leaf litter.

The subfamily Chrysomelinae contains the largest members of the family and most of them are brightly colored and well known (e.g., Colorado potato beetle, milkweed leaf beetle, cottonwood leaf beetle, etc.). The adults and larvae eat leaves of various plants (Solanaceae, Salicaceae, Cruciferae, Compositae) and several species are of economic importance.

Most members of the subfamily Galerucinae are root feeders in larval stages. However, some like *Trirhabda neoscotiae* Blake, common in the Park, feed on leaves of goldenrods; the larvae are black and shiny and the adults are striped with black and yellow.

The subfamily Alticinae or flea beetles (about 100 species) are recognized immediately because they can jump with their enlarged hind legs. The fauna of the Park is poorly known. Root feeders, root miners, stem miners, leaf miners of leaf eaters in larval stages, they all feed on leaves of a large variety of plants in the adult stage. Several species are serious pests of cultivated plants.

Some of the more abundant or noticeable species of chrysomelids in the Park include the species *Plateumaris emarginata* (Kirby) which feeds on *Scirpus-Juncus* stands in ditches, road sides, bogs, margins of rivers, etc. Also the Galerucinae beetles *Tricholochmaea kalmiae* (Fall) on sheep laurel (*Kalmia angustifolia* L., *T. spiraeae* (Fall) on large-leaved meadow-sweet (*Spiraea latifolia* (Ait.) Borkh. and *T.* near *tuberculata* Say on willow. *Trirhabda neoscotiae* Blake is a yellow galerucine leaf beetle with black stripes that feeds on goldenrod. This species is known only from Nova Scotia and is relatively abundant in the Park.

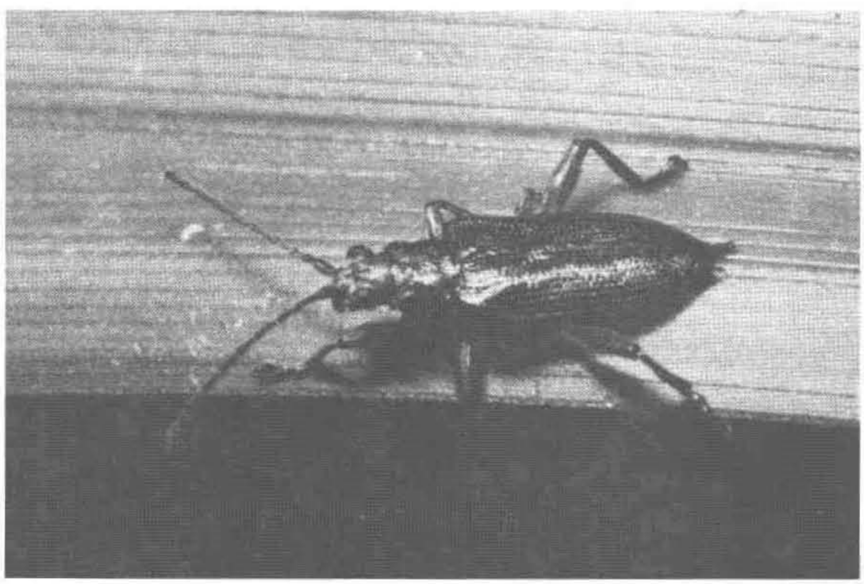


Fig. 3. *Plateumaris* sp.: a common chrysomelid beetle on aquatic plants

Table 5. - List of Chrysomelidae from Cape Breton National Park -

Subfamily Donaciinae
- *Plateumaris chalcea* (Lacordaire)
- *P. emarginata* (Kirby)
- *P. fulgens* (LeConte)
- *P. metallica metallica* (Ahrens)
- *P. proxima* (Kirby)
- *P. pusilla* (Say)

Subfamily Orsodacninae
- *Orsodacne atra* (Ahrens)

Subfamily Cryptocephalinae
- *Cryptocephalus notatus* Fabricius
- *C. quadruplex* Newman
- *Bassareus formosus* (Melsheimer)

Subfamily Chrysomelinae
- *Calligrapha ignota* Brown
- *Chrysomela mainensis mainensis* Bechyné
- *Phratora americana canadensis* Brown

Subfamily Galerucinae
- *Trirhabda neoscotiae* Blake
- *Galerucella quebecensis* Brown
- *Tricholochmaea kalmiae* (Fall)
- *T. spiraeae* (Fall)
- *T.* nr. *tuberculata* (Say)
- *Scelolyperus cyanellus* (LeConte)
- *Phyllobrotica decorata* (Say)

Subfamily Alticinae
- *Phylotreta cruciferae* (Goeze)
- *P. striolata* (Fabricius)
- *Altica corni* Woods
- *A.* nr. *sylvia* Malloch
- *Crepidodera* sp.
- *Capraita subvittata* (Horn)
- *Psylliodes punctulata* Melsheimer

Superfamily Curculionoidea

Family Scolytidae (by D.E. Bright)

The Scolytidae, or bark beetles, are small insects that occur under the bark of dead and dying trees. The species are well known taxonomically for Canada (Bright 1976). All members feed and reproduce in the cambium region (true bark beetles) or deep in the wood (ambrosia beetles). All of the woody parts of a tree may be attacked, but each species of bark beetle usually restricts its activities to a particular part of the tree. For example, species of *Pityophthorus* are found in smaller branches or twigs, those of *Ips* are found in larger branches, bole and tops, those of *Dendroctonus* in the bole and roots, etc.

The scolytid fauna in the Park is somewhat depauperate due to the paucity of potential host plants and perhaps due to the isolation of some plant communities. For example, the jack pine stand along the Jack Pine Trail was examined several times during the survey. No trace of bark beetles usually associated with jack pine was found. If the common species occur there, they must be in low numbers, at least that year. Another potential host plant, white pine, is scattered in the eastern part of the Park. This tree has a large number of bark beetle associates wherever it occurs in Canada but only a few were found in the Park, due no doubt to the relatively infrequent occurrence of the host.

It is possible that as many as 35 species of Scolytidae could occur in the Park; however, only 18 were collected during the survey. If indeed there are more species yet to be found in the Park, they will probably be found in the white pine stands, in the jack pine stands or in hosts such as willow or larch.

The species collected in the Park are listed below with additional information on hosts, distribution, etc.

1) *Cryphalus ruficollis* Hopkins. Found throughout the Park in small branches of spruce and fir. Occurs throughout Canada wherever its hosts occur.

2) *Crypturgus borealis* Swaine. Occurs throughout the Park in down trunks or large branches of spruce. A very small beetle that occurs only in trunks after other species, such as *Ips* or *Dendroctonus*, have completed their life cycle.

3) *Dendroctonus rufipennis* (Kirby). The most destructive species of Scolytidae in eastern North America. It has established very high populations (epidemic) in the MacIntosh Brook area, Pleasant Bay and Warren Lake. In the MacIntosh Brook area, virtually every spruce above 6" DBH had been attacked (1983). The same holds true for the area just east of Pleasant Bay. In the Warren Lake area, all the large spruce in the parking and picnic areas have been attacked; all will probably be dead within a few years. This species occurs throughout North America in various species of spruce.

4) *Dryocoetes affaber* (Mannerheim). Occurs throughout the Park in dead and dying spruce. The species is of no economic importance. It occurs throughout North America wherever its hosts occur.

5) *Dryocoetes autographus* Ratzeburg. Same as above. This is a larger species that occurs in the same habitats.

6) *Hylurgopinus rufipes* (Eichhoff). This is the "native elm bark beetle", the vector of Dutch-elm disease. While not actually found in the Park, it has been collected at Margaree Forks, southwest of the Park. This species will be found in the Park wherever mature elms are found.

7) *Ips borealis* Swaine. Found throughout the Park in recently dead spruce. A species of only marginal economic importance, usually found in tops of standing trees attacked by *Dendroctonus rufipennis* or in boles of fallen trees. Found throughout northern North America in spruce.

8) *Monarthrum mali* Fitch. Found only at Lone Shieling in various species of deciduous trees. The Lone Shieling collection is a new record for Nova Scotia. This species is an "ambrosia beetle"; the adults bore deeply into the sapwood and the larvae live on ambrosial fungus taken into the galleries by the attacking adults. This species occurs throughout eastern North America.

9) *Orthotomicus caelatus* Eichhoff. A species with habits similar to those of *Ips borealis*. Found throughout North America wherever its hosts, spruce and pine, occur.

10) *Pityogenes hopkinsi* Swaine. Found in the Park only where white pine occurs. A common species in small fallen limbs, branches or tops. Found throughout eastern North America.

11) *Pityokteines sparsus* LeConte. Found only in boles and large limbs of balsam fir throughout the Park. Occurs throughout eastern North America.

12) *Pityophthorus* spp. A group of 4 or 5 very small species found in dying branches of spruce and pine. They are of no economic importance and their identity can only be determined by a specialist.

13) *Polygraphus rufipennis* (Kirby). This species, the "four-eyed spruce beetle", is found throughout the Park in dying spruce. It is extremely common and of no economic importance. Found throughout North America, mostly in spruce but also in other coniferous trees.

14) *Scierus annectans* LeConte. Occurs in dead spruce logs when the cambium has begun to deteriorate. Widespread in eastern Canada but rarely collected. Its hosts include spruce, fir and pine.

15) *Scolytus piceae* Swaine. Found in large, green limbs on fallen spruce and is of no economic importance. Occurs throughout Canada wherever its hosts occur.

16) *Trypodendron lineatum* (Olivier). Found throughout the Park in dead and dying spruce and jack pine. It is one of two species found attacking jack pine along the Jack Pine Trail. Normally, at least a dozen species should have been found in jack pine. This species is an ambrosia beetle and is common throughout Canada wherever its hosts are found.

17) *Xyleborus dispar* (Fabricius). This ambrosia beetle was commonly collected at Lone Shieling and infrequently collected elsewhere. It occurs in all species of deciduous trees and is found in eastern Canada and in southern British Columbia. It is an introduced species and is a serious pest in orchards.

18) *Xyloterinus politus* (Say). A species commonly collected at Lone Shieling. Occurs in most species of deciduous trees and has habits very similar to those of *Trypodendron lineatum.* Found throughout eastern Canada.

Species that should occur in the park

The following species were not collected during the Park survey but should occur in the Park since the host plant occurs there.

White Pine	- *Hylurgops pinifex* Fitch, in stumps and large trunks - *Hylastes parculus* Erichson, in stumps - *Dendroctonus valens* LeConte, in stumps and lower part of bole - *Conophthorus coniperda* Schwarz, in cones
Jack Pine	- *Conophthorus resinosae* Hopkins, in cones - *Pityogenes plagiatus* (LeConte), in small limbs and twigs - *Ips pini* Say, in fallen trunks and large limbs
Spruce	- *Dendroctonus punctatus* LeConte, in lower part of bole - - rare - *Phloeosinus pini* Swaine, in limbs or small part (top) of bole - *Phloeotribus piceae* Swaine, in small limbs or boles - *Crypturgus pusillus* (Gyllenhall), in fallen trunks
Willow	- *Trypophloeus populi* Hopkins and *T. striatulus* - (Mannerheim) in twigs or small branches
Spruce and pine	- *Pityophthorus* spp., in small branches and limbs
Larch	- *Dendroctonus simplex* LeConte, in boles of moderate to large standing trees

The family Curculionidae (weevils), is the largest family of Coleoptera with over 60,000 species named from throughout the world. Although the Canadian fauna has never been accurately tabulated, at least 1,000 species are suspected to occur in the country and at least 400 species in eastern Canada. About 100 species are estimated to occur in the Park, but only about 60 species were collected.

Most of the species are common, widely distributed eastern North American species. However, some such as *Philopedon plagiatus* (Schaller), *Barynotus obscurus*, *B. schoenherri*, and *Barypeithes pellucidus* (Boheman) were introduced into North America from Europe. There are also a number of economic pests in the Park including *Rhynchaenus pallicornis* (Say) (the apple flea weevil), *R. rufipes* (LeC.) (the willow flea beetle), *Tychius picirostris* (Fab.) (the clover seed weevil), and *Anthonomus signatus* Say (the strawberry weevil).

Acoptus suturalis LeC., which occurs in dead wood of beech, maple and ironwood, and *Rhyncolus brunneus* Mann., which occurs under bark of dead trees, were new records for Nova Scotia.

References

Anderson, R.S. and S.B. Peck. 1985. The insects and arachnids of Canada. Part 13. The carrion beetles of Canada and Alaska. Agriculture Canada publication 1778. 121 pp.

Bright, D.E. 1976. The Insects and Arachnids of Canada, Part 2. The Bark Beetles of Canada and Alaska (Coleoptera: Scolytidae). Can. Dep. Agric. Publ. 1576. 241 pp.

Campbell, J.M., *et al.* 1979. Coleoptera, *In* Danks, H.V. (Ed.), Canada and its insect fauna. Mem. Entom. Soc. Canada No. 108, pp. 357-386.

Crowson, R.A. 1981. The biology of Coleoptera. Academic Press, 802 pp.

Lindroth, C.H., 1961-1969. The ground-beetles (Carabidae, excl. Cicindelinae) of Canada and Alaska. Opusc. Ent. Suppl., 20 (1961), 24 (1963), 29 (1966), 33 (1968), 34 & 35 (1969): 1192 pp.

Pacheco, F. 1964. Sistematica, filogenia y distribucion de los Heteroceridos de America (Coleoptera: Heteroceridae). Monografias del Colegio de Post-graduados: No. 1, Chapingo, Mexico. 155 pp.

Thiele, H.-U. 1977. Carabid beetles in their environments: a study of habitat selection by adaptations in physiology and behaviour. "Zoophysiology and Ecology", vol. 10. New York, Springer-Verlag. 396 pp.

Wood, D.M. 1964. Studies on the beetles *Leptinillus validus* (Horn) and *Platypsyllus castoris* Ritsema (Coleoptera: Leptinidae) from beaver. Proc. ent. Soc. Ont. 95: 33-63.

Order Mecoptera (scorpion flies)

by J.E.H. Martin and S. Allyson

This small diverse order contains about 25 species in Canada that belong to four families, each with a single genus: *Panorpa*, *Bittacus*, *Boreus* and *Merope*. A species of *Panorpa* was collected during the survey and species of *Bittacus* and *Boreus* also probably occur in the Park.

Order Diptera

by D.M. Wood, with assistance from B.M. Bissett, A. Borkent, B.E. Cooper, M.E. Dillon, J.F. McAlpine, D.R. Oliver, H.J. Teskey and J.R. Vockeroth

All true flies, including mosquitoes, midges, gnats, house flies, blow flies and their relatives, belong to the order Diptera. The Diptera are one of the most prominent groups of insects in Canada, not only in numbers of species (7000 have already been named and perhaps twice this number remain to be named), but in numbers of individuals. The blood-sucking or pestiferous habits of a few species have given the entire order a bad name, but in reality, the vast majority of flies are either beneficial or innocuous. The beneficial species include parasites and predators of caterpillars, beetles and other plant-feeding pests, and some are pollinators, such as the flower flies. Unfortunately, the blood-sucking species, especially those which transmit disease organisms, can cause havoc out of all proportion to their numbers, and tend to offset, in the minds of the public at least, the good qualities of so many other fly species.

All adult flies may be readily recognized and distinguished from all other insects by having only one pair of functional wings, and a pair of club-like halters behind them, in reality the highly modified hind wings, which are used as balancers. A few unusual flies have lost their functional wings; they almost always have retained their halters, however, and may thus be still recognized as flies. During flight, the halters vibrate rapidly up and down, and are believed to act as a pair of gyroscopes, helping the fly remain on an even keel during rapid flight. Some kinds of flies, especially flower flies, male horse flies and bee flies, can hover at a point in space for minutes at a time. This ability is especially useful when bee flies are visiting flowers, hovering in front of them much as would a hummingbird or sphinx moth. Few other insects, among them sphinx moths, dragonflies and some species of mayflies, can hover in one place so effectively.

All Diptera pass through four successive life forms, egg, larva, pupa and adult. Eggs of most flies are not very distinctive, nor readily distinguishable from eggs of other insects. They may be soft and white, or hard-shelled and dark-coloured, depending on whether they are destined to hatch soon or survive long periods of adverse weather conditions such as winter or drought. They are usually deposited on or close to a suitable source of food for the hatchling larva. All growth takes place in the larval stage, and the larva, whose cuticle, or skin, is distensible but not infinitely so, must moult, or shed its skin, several times as it grows. Before each moult the new cuticle forms inside the old; when fully formed, the old cuticle splits and the larva crawls out of it, leaving it behind. The larva is now said to be in the next instar; most fly larvae pass through four instars, each somewhat different from the others. The first instar, the one that hatches from the egg, is usually the most highly differentiated, often hardly recognizable as belonging to the same species as its subsequent instars. Such extreme modifications are usually related to specialized behaviour, such as having to search for suitable hosts to burrow into and parasitize, or burrow into the ground or some other substrate, or hitch a ride on an intermediate host. All larvae of Diptera, in all instars, lack true legs, although some species, especially aquatic ones, have developed secondary pseudopods on the ventral side of their bodies, for clinging to the substrate beneath swiftly running water.

Larval development may be rapid, occupying only a few days in the case of house fly and blow fly maggots, or may take a year, two years or in the far north perhaps even longer. When growth is completed, however, all larvae must seek a suitable site to pupate. The pupa is the most vulnerable stage in the life cycle of most flies, and is usually of short duration, sometimes only a few days. Most flies pupate in the soil; even among aquatic flies the majority leave the water to pupate in the wet soil along the banks. Midges (Chironomidae), however, pupate and breathe under water by means of gills, but the pupa must swim to the surface just before the adult emerges. Pupae of mosquitoes (Culicidae) swim about actively in the water, but they too must come to the water surface not only to breathe, but so that the adult can emerge into the air. Net-winged midges (Blephariceridae) and black flies (Simuliidae) are notable exceptions; they pupate under swiftly flowing water, either cemented to the bottom (Blephariceridae) or hooked into a silken cocoon which itself is attached to an underwater object. The pupae do not come to the surface; instead the adult emerges underwater, enveloped in a film of gas, and floats to the surface, where it is able to break free of the surface tension and take wing.

Whether the adult emerges from the water or the soil, a few hours must elapse before its cuticle becomes fully hardened. Males usually emerge a few days ahead of females; their gonads require a little time to develop. Both sexes need fequent meals of nectar and must either visit flowers, honey dew or some other carbohydrate source regularly, probably at least daily. Males, when not visiting flowers or resting, spend their entire lives searching for receptive females. Rather than searching at random throughout the environment, where chance encounters could be most unlikely, males of the majority of species tend to aggregate at certain places, where they await the arrival of unmated females. A given species may be predictably found, year after year, at one of these aggregation sites. One of the most common aggregation sites, not only for many species of flies, but for other insects as well, is a hilltop. On a warm morning in summer, prominent hilltops, such as those on which the fire towers stand, may be buzzing with many species of male flies, hovering, or resting on foliage around the towers and associated structures. Each species has its own particular niche, where often many individuals may be found day after day. Species that do not hilltop may aggregate at other locations, called swarm markers, along water courses, in depressions in meadows, or along the edges of ponds or lakes. Mosquitoes and midges are most noticable at such sites, especially at dusk and dawn, where huge swarms of flying males may be seen drifting slowly about. Receptive females approaching the swarm are seized by the nearest male. Since mating, and mated pairs, are normally only encountered in the vicinity of aggregation sites, it may be safely assumed that the purpose of aggregation behaviour in males of so many species of flies is to bring the sexes together in a small enough area for the majority of individuals to find mates, presumably also at a time when predation is minimized.

Another important feature of many flies is the need, by the female, of a protein meal, used to nourish her developing eggs. It is now believed that the ancestors of the Diptera were predaceous on other insects, capturing them in flight and piercing the cuticle to suck out the body fluids. Some species of extant flies have retained this habit; for example, females of some species of Ceratopogonidae inhabiting the Park capture smaller insects for food in this way. A few species in the latter family even devour the body contents of the male while he is mating with her. From sucking body fluids of other insects, it is perhaps not to great a jump to larger animals, and the habit of sucking vertebrate blood is presumably derived from predation on other insects. Among Ceratopogonidae, one finds different species that demonstrate all these types of blood-sucking, from predation on smaller insects, to sucking the blood of much larger insects, to sucking the blood of vertebrates.

The earliest fossils that can be definitely assigned to the Diptera are wing prints from the upper Triassic period, about 190 million years old. Even these early fossils show that the order had already differentiated into several of the major subdivisions we see on earth today, suggesting that the earliest Diptera date back to the Permian period or earlier, more than 225 million years ago.

The order Diptera is divided into two suborders, the Nematocera and the Brachycera. The Nematocera comprise mosquito-like, midge-like, or crane fly like insects, with elongate antennae subdivided into many similar segments (hence the name), and usually also long slender legs. The suborder Nematocera is in turn subdivided into seven infraorders , *viz.* Tipulomorpha (crane flies), Blephariceromorpha (net-winged midges), Axymyiomorpha, Bibionomorpha, Psychodomorpha, Ptychopteromorpha and Culicomorpha (mosquitoes, black flies, no-see-ums and midges). All of these suborders, except Axymyiomorpha, has representatives in Cape Breton Highlands, and each will be treated in more detail below. Larvae of Nematocera usually have distinct, fully-exposed, head capsules, with well-developed readily-distinguishable, mouthparts. They are mostly vegetarian, feeding by biting off pieces of vascular plants or fungi, by scraping algae and other unicellular organisms from wet surfaces, or by filtering algae, detritus, and other particles suitable for food from water. The Brachycera are subdivided into three suborders, Tabanomorpha (in which belong horse flies and deer flies), Asilomorpha and Muscomorpha (house flies, blow flies, and their relatives). Adults of this suborder are usually stouter, with shorter antennae, that usually consist of three large basal segments, while the remaining segments are reduced in number and usually partly fused into a terminal style or bristle, but there is considerable variation. Larvae of Brachycera have reduced, retractable heads, and their hook-like mandibles, which move in a vertical rather than a horizontal plane, are usually the only readily-discernable mouthparts. They are both vegetarians and predators. Those of horse flies and their relatives are vicious predators. Their mandibles are equipped with poison glands like the fangs of poisonous snakes. Their prey usually consists of other insects, but may also include small frogs. Larvae of members of the Muscomorpha, which are called maggots, have reached the ultimate in head reduction, with scarcely more than a pair of hook-like mandibles protruding from the front end of the larva. This extreme reduction, along with adaptation for feeding on unicellular organisms in a liquid or semiliquid medium, has led to scavenging in rotting vegetation, carcasses and dung. This behaviour has, in turn, developed, probably independently many times, into both external and internal parasitism of both vertebrates and invertebrates, as well as internal feeding in plants, in the form of stem, leaf and root mining.

Census of Diptera of Cape Breton Highlands National Park

	Estimated number of species in Eastern Canada	Number of species recorded in Cape Breton Highlands N.P.
SUBORDER NEMATOCERA		
Infraorder Tipulomorpha		
Tipulidae	400	?
Infraorder Blephariceromorpha		
Blephariceridae	2	1
Infraorder Bibionomorpha		
Bibionidae	20	4
Mycetophilidae	350	?
Sciaridae	?	?
Cecidomyiidae	?	37+
Infraorder Psychodomorpha		
Psychodidae	?	?
Trichoceridae	6	?
Anisopodidae	5	3
Scatopsidae	19	?
Infraorder Ptychopteromorpha		
Tanyderidae	1	1
Ptychopteridae	2	2
Infraorder Culicomorpha		
Dixidae	9	1
Chaoboridae	12	1
Culicidae	59	10
Thaumaleidae	1	1
Simuliidae	56	5+
Ceratopogonidae	184	33
Chironomidae	?	?
SUBORDER BRACHYCERA		
Infraorder Tabanomorpha		
Tabanidae	97	39
Rhagionidae	29	6
Stratiomyidae	60	6
Xylomyidae	1	1
Xylophagidae	8	4
Infraorder Asilomorpha		
Asilidae	60	15
Therevidae	11	3

Acroceridae	16	1
Bombyliidae	28	6
Empididae	?	?
Dolichopodidae	350	100
Infraorder Muscomorpha		
Division Aschiza		
Lonchopteridae	4	2
Platypezidae	17	3
Phoridae	64	?
Syrphidae	286	113
Pipunculidae	35	?
Division Schizophora		
Subdivision Acalyptratae		
Conopidae	24	2
Micropezidae	5	1
Psilidae	14	3+
Lonchaeidae	100	25
Otitidae	29	3
Tephritidae	55	6+
Piophilidae	12	3
Clusiidae	18	5
Acartophthalmidae	2	1
Agromyzidae	100	?
Odinnidae	8	1
Anthomyzidae	8	5
Opomyzidae	4	2
Aulacigastridae	2	1
Asteiidae	5	1
Milichiidae	18	?
Coelopidae	1	1
Tethinidae	?	1
Sciomyzidae	82	24
Sepsidae	15	?
Lauxaniidae	55	11
Chamaemyiidae	15	2
Heleomyzidae	37	?
Sphaeroceridae	35	?
Drosophilidae	50	7
Diastatidae	5	2
Ephydridae	130	?
Chloropidae	125	?
Subdivision Calyptratae		
Scathophagidae	105	38
Anthomyiidae	175	?
Muscidae	335	93
Calliphoridae	22	10
Oestridae	14	2
Sarcophagidae	38	16+
Tachinidae	430	60+
Hippoboscidae	10	?

Suborder Nematocera

Representatives of 19 families, divided among six infraorders, belonging to this suborder, were collected in Cape Breton Highlands National Park. The largest and most diverse of these, the crane flies (Tipulidae), midges (Chironomidae), gall midges (Cecidomyiidae) and fungus gnats (Mycetophilidae) are probably much richer in species than our records indicate.

Family Tipulidae (crane flies).

More species of crane flies have been described than in any other family of Diptera. This does not necessarily mean that it is the largest family, only that has been studied more thoroughly than Cecidomyiidae, Mycetophilidae or other contenders for the largest family. Crane flies may be found in virtually every habitat, but are particularly diverse in the vicinity of wet areas. Their larvae inhabitat a variety of aquatic, semiaquatic and terrestrial habitats, where they live buried in soil or decaying vegetation, feeding on moss, leaves, decaying wood and other detritus. Larvae of a few species are predators of other insects. Adult crane flies, often called daddy-long-legs (a name also applied to harvestmen, a group of arachnids), are sometimes confused with mosquitoes, but they are incapable of sucking blood and are harmless. They have exceptionally long legs, which are readily detachable at the base. Perhaps this adaptation allows them to escape from predators, or from spider webs, with one or two fewer legs but otherwise unscathed. Loss of legs apparently is no great detriment, for crane flies may often be collected with fewer than the normal number of six. Among the most unusual crane flies in Canada are the wingless members of the genus *Chionea* which crawl about on top of the snow during winter; although none was collected in Cape Breton (because collecting was not carried out in winter) they may occur there.

Family Blephariceridae (net-winged midges).

Larvae of one species of net-winged midge, *Blepharicera tenuipes* (Walker), were collected in the Cheticamp river and in the creek flowing through Lone Shieling. Larvae of all members of this family are fully aquatic, living on stones in fast running water. They cling to the rocks by means of a longitudinal row of six large suction cups on their ventral surfaces, feeding on algae growing on the rocks. Pupae are formed on the same rocks, cemented in place by paired glands along the side of the body. On emergence, the adult must escape from the pupal skin, expanding its legs and wings as it emerges, and rise to the surface of the swiftly flowing water covered in a film of gas, presumably taking flight the moment it breaks the surface. Adults were collected flying over the Cheticamp River at dusk.

Family Bibionidae (March flies).

These flies presumably acquired their name from the habit, characteristic of some common members of the genus *Bibio*, of emerging in early spring. They are rather clumsy insects, seemingly vulnerable to predators, but their resemblance to ants may confer on them some protection. Another entirely black species, *Penthetria heteroptera* (Say), flies in late fall, and probably occurs in the park although it was not collected. It may be protected by its own unpleasant odour, which resembles, to this observer, that of fireflies and related beetles. Larvae live in the soil, feeding on roots and probably also decaying matter. A common European species can be a pest of cereal crops. Females of *Bibio* have a curved spur at the apex of each fore leg which they use to dig themselves into the soil prior to oviposition.

Families Mycetophilidae and Sciaridae (fungus gnats).

These two families are discussed collectively because they resemble each other closely, and because the latter is regarded by many as merely a subgroup of the former. Their larvae, as their name implies, inhabit fungi, and are among the first insects to attack mushrooms. Although present throughout the summer, they are particularly abundant in the autumn, when the greatest array of fungi are present. Members of the subfamily Mycetophilinae are most often encountered in mushrooms of almost all species (not surprisingly, highly poisonous members of the genus *Amanita* escape attack), while members of other subfamilies burrow in rotten wood that is riddled with fungal hyphae. An unusual example of specialization occurs in the subfamily Keroplatinae, whose members spin silken webs beneath bracket fungi. The webs capture falling spores of the fungi, which serve as food for the larvae. A few members of this group are predaceous, capturing minute midges in their webs in a manner analagous to that of spiders. Some of these predaceous larvae are even luminescent; one famous luminescent species living in caves in New Zealand spins dangling threads to capture its prey. Although a luminescent species occurs in Eastern Canada, none was taken in Cape Breton.

Family Cecidomyiidae (gall midges) (by A. Borkent).

This family of flies, commonly known as gall midges, is one of the most species-rich in Canada and in the Park. Probably because they are small and fragile, they are also very poorly known. Undoubtedly, most of the species in the Park are undescribed and not named. This family is closely related to the Sciaridae, and may be an offshoot of that group. The two families share the unusual characteristic of eliminating, at certain stages of cell division, some of their chromosomes. Larvae of the more primitive members of this family are also associated with fungi, but many species, belonging to the subfamily Cecidomyiinae, have developed the ability to form galls on vascular plant tissues. The gall may assume a wide variety of shapes, colours and textures. Different species of midge may be recognized by the shape, position, size and other characteristics of the gall. It is also assumed that many species are host-specific, i.e., each vascular plant is attacked by its own unique species of cecidomyiid, but this has not been rigorously tested in most cases. The larva develops inside the gall, and may feed either on plant tissues, which proliferate as a sort of cancerous growth, or may feed on fungi developing within the gall. Some larvae leave the gall and pupate in the soil while others remain in the galls to pupate. In spite of this lack of knowledge, some species, or at least evidence of their presence, can be easily observed. For example, *Acericecis ocellaris* (Osten Sacken) larvae form bright red spot galls on *Acer rubrum* (red maple) leaves in June and early July (Fig.), *Asteromyia* species form dark blister galls on the leaves of a variety of composites but may be especially common on *Solidago* (goldenrod) and *Paradiplosis tumifex* Gagné forms swellings at the base of balsam fir needles. Indeed cecids may be found producing a wide array of different types of galls on a wide variety of different plants. It should be noted however that some other insects, such as thrips, aphids, some wasps and some moths, also produce galls so that care must be exercised in diagnosing a particular gall as being produced by a cecidomyiid.

Although members of this family are called gall midges, genera most genera do not form galls at all. *Bremia* and *Lestodiplosis* species are predaceous as larvae, *Winnertzia* species feed on mushrooms and the larvae many species of a variety of genera (e.g. *Peromyia, Aprionus, Bryomyia, Cordylomyia*) live in soil, in decaying vegetation, or under the bark of dead trees. Larvae of *Cecidomyia* species live in extruded pitch masses on the trunks and branches of coniferous tree species.

Adults are not commonly seen with the naked eye. Generally large numbers can be collected, but only with nets or traps. One exception are species of the genus *Anarete*. Males form very tight, busy swarms near the tips of conifer branches on calm, bright days in June and July.

The following is a list of genera collected in the park and, where possible, some are further identified to species (* = first Nearctic record).

Anarete
Lestremia cinerea Macquart
Anaretella spiraeina (Felt)
Aprionus
Bryomyia
Cordylomyia
Peromyia
Monardia
**Heterogenella*
**Skuhraviana*
**Micropteromyia* (?)
Claspettomyia
Porricondyla
Isocolpodia
Haplusia
Parepidosis
Winnertzia
Camptomyia
Asynapta
Didactylomyia
**Trichoxylomyia*
Dasineura
Mayetiola
Asteromyia carbonifera (Osten Sacken)
Calamomyia
Neolasioptera (?)
Paradiplosis tumifex Gagné
Macrodiplosis (?)
Bremia
Karshomyia
Lobodiplosis
Lestodiplosis
Planetella
Acercecis ocellaris (Osten Sacken)
Cecidomyia
Clinodiplosis
Brachyneura

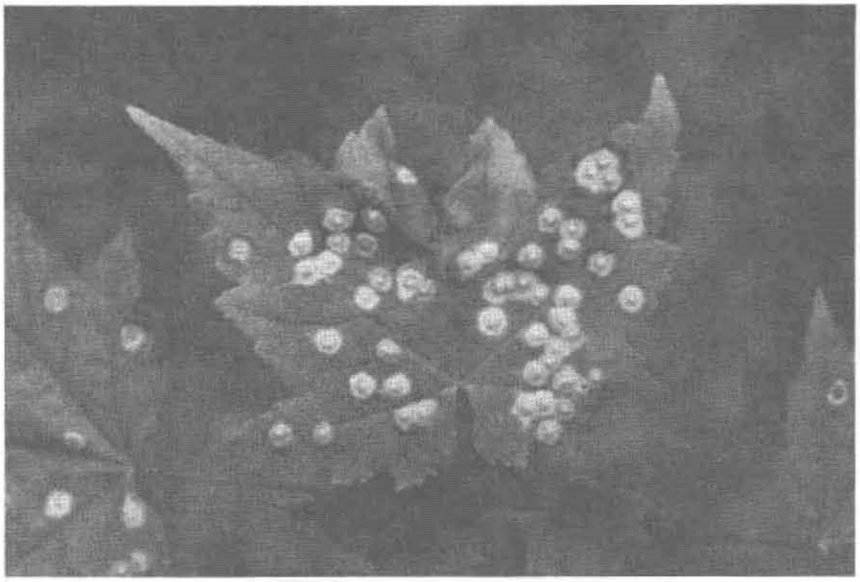


Figure 4. Galls of Acericecis ocellaris on leaves of red maple.

Psychodidae (moth flies).

As their name implies, moth flies are tiny, stout-bodied flies with broad wings, covered with scale-like hairs. Larvae occupy damp habitats, where they feed on microorganisms. A common species breeds in drains and sewers, and adults may be encountered indoors. Others may be found in the vicinity of fermenting sap, or tree-holes. The family is poorly studied, and no estimate of the species occurring in Eastern Canada can be made at the present time.

Family Trichoceridae (winter crane flies).

Adults of this small family superficially resemble small true crane flies of the family Tipulidae, but their larvae are much more like those of the following family. Adults are among the earliest and latest Diptera to be on the wing, and male swarms may be seen in late afternoon during warm spells in March and November. Larvae feed on microorganisms in fermenting sap seeping from tree-wounds. Larvae have also been found in decomposing fungi and in dung, where they are also presumably feeding on microorganisms. These organisms are harvested by means of brushes on the mandibles, in a manner identical to larvae of the previous and two following families.

Family Anisopodidae

Larvae of anisopodids also feed on microorganisms in moist decomposing vegetation, including fermenting sap and dung. One species of *Sylvicola* feeds in cow dung and is probably common around the edges of the Park wherever cattle are present.

Family Scatopsidae (minute black scavenger flies).

Adults resemble tiny black flies, but do not bite. Larvae may be found wherever rotting vegetation is present, and may be abundant around composted leaves.

Family Tanyderidae (primitive crane flies).

Only one species of this rare and unusual family, *Protoplasa fitchii* Osten Sacken, occurs in eastern Canada, where it is confined to the Appalachian Region, from the Gaspé and Cape Breton to Georgia. Specimens were collected in late June as they flew at dusk over Cayburn Brook. The species is probably fairly common in the Park, and is one of its most interesting and unusual Diptera. Adults superficially resemble true crane flies (Tipulidae), but they are probably not closely related. Larvae, which were first discovered in the Gaspé Peninsula, burrow in the gravel of stream beds, where they are quite difficult to collect. Their diet is unknown, although it is assumed that they feed on detritus trapped between the gravel. When ready to pupate, they make their way to the stream bank, and the adult emerges in the grass along the edge of the stream. On at least two previous occasions, in Gaspé and in Maine, males were found in large numbers, swarming over bridges at dusk, and one might expect similar swarms in the vicinity of Clyburn Brook, although they were not searched for until late June, perhaps after the peak numbers had already occurred.

Family Ptychopteridae (phantom crane flies).

Members of this family also superficially resemble true crane flies. The largest and best known member, *Bittacomorpha clavipes* (Fabricius), has long, black and white banded legs, which are carried extended like spokes of a wheel when in flight. Its flight is also extremely slow, the insect resembling a drifting piece of milkweed fluff. Larvae of *B. clavipes* live in springs and seepages, immersed in layers of diatoms and other algae on the bottom. They feed by harvesting this algae with their labral brushes. By means of an extremely long, telescopic thread-like siphon, they can breathe air while remaining buried in the detritus on the bottom. Other members of the family are less spectacular, but also live submerged in detritus and feed in a similar manner. In addition to *clavipes*, one other species of ptychopterid, *Ptychoptera quadrifasciata* Say, was collected. It looks much like a medium-sized crane fly.

Family Dixidae (dixid midges).

Although related to mosquitoes, adult dixids have no biting mouth parts and are of no economic importance. Larvae live at the interface between water and air, usually along the edges of streams, where they assume an inverted U-shaped position on stones and emergent vegetation. They feed on floating particles, such as pollen and algae, which they strain from the surface of the water with their extremely complex mouthparts. One species, *Dixa nova* (Walker), was fairly plentiful in samples taken in the Park.

Family Chaoboridae (phantom midges) (by A. Borkent).

Although there are only a few species in the family, some of these play a major role in aquatic communities. The predaceous larvae of the genus *Chaoborus* can occur in huge numbers and affect the presence and numbers of other species of zooplankton. Only one species, *Chaoborus americanus* (Johannsen), was collected in the Park. Large swarms of males (adults are about as large as mosquitoes) were observed at Ingonish Campground in the last two weeks of June in 1983. Larvae of this species occur in permanent ponds in exposed sunlit areas.

Family Culicidae (mosquitoes).

Adult mosquitoes may be distinguished from other similar-sized midge-like flies by their long slender proboscis. Under a microscope their body, legs and wings are more or less covered with flattened coloured scales, which form patterns characteristic of each species. Of all the flies that suck blood, mosquito mouth parts are the most sophisticated. Although possessing the same components as any other biting nematoceran, a pair of mandibles, a pair of maxillae, a labrum (upper lip), a hypopharynx (tongue, which carries the salivary duct) and a labrum (lower lip), the mouthparts of a mosquito are extremely elongate and thread-like. In spite of their delicate appearance, mandibles, maxillae, labrum and hypopharynx are all capable of being thrust into the skin of the intended victim. Only the labium remains outside the skin. The mandibles penetrate like needles, while the maxillae, equipped apically with recurved hooks, are used as anchors as the mandibles are shoved deeper into the skin. The tips of these stylets can be moved about beneath the skin in search of a capillary. Once a capillary is located the mosquito can then drink directly from the source of supply. These adaptations are unique among biting flies, for only mosquitoes are thus adapted to penetrate the skin and tap a capillary. Other biting flies, such as black flies and horse flies simply tear or slice the skin and lap up the blood that wells up in the wound.

Our survey in the summers of 1983 and 1984 indicated that Cape Breton Highlands, compared to other boreal areas of Canada, is not especially cursed with large numbers of mosquitoes, either in numbers of species or of individuals. In other parts of Canada, mosquitoes are particularly numerous when the ground is underlain by permafrost or impervious rock (for example, the Canadian Shield), or where the water table remains high because of proximity to large bodies of water or to the sea. Permafrost does not exist in the Park, and there are no large lakes or rivers that are subject to overflowing into bottomlands. The Park, however, does have a large area of water associated with bogs, but this water seems to be constantly seeping through the bog surface, leaching nutrient material with it. Bog pools do support larvae, but not in the enormous numbers that one might find in a similar area in northern Quebec, for example. Only ten species were collected, as follows:

Aedes abserratus (Felt & Young). Only a few adults of this species were collected, 4.8 km north of Ingonish, along the Jack Pine Trail and at Pleasant Bay, all in early July. Larvae occur in a variety of habitats, but have most often been found in boggy situations, associated with larvae of *Aedes canadensis* and *A. punctor*. The species is confined to Eastern Canada, and is seldom abundant, except in places in the Maritime Provinces.

Aedes atropalpus (Coquillett). Larvae of this species were collected in pools of rainwater that had accumulated in depressions on flat, exposed rocks bordering Halfway Brook, Neils Harbour. This species breeds only in such habitats, usually heated by the sun, often becoming quite warm in hot weather. This collection appears to be the first record for Nova Scotia, and may be the first for the Maritime Provinces. Its distribution in Eastern North America, to which it is confined, is sporadic, presumably because its larval habitat, exposed rock pools, are not continuously distributed. Adult females are autogenous in their first gonotrophic cycle, meaning that they do not require a blood meal to mature their first egg batch, although they may take a blood meal in order to develop a second or subsequent egg batch. This lack of interest in blood may also help to explain their scarcity in collections, for they are not attracted to humans until they have already deposited their first batch of eggs.

Aedes canadensis (Theobald). Larvae of this species comprised the majority of collections of larvae taken in the Park. They were collected in a wide variety of situations, particularly in small pools in bogs and forested areas. One collection was made on the flat rock, mentioned above, bordering Halfway Brook, but only in cool spring-fed pools. Larvae were thus not coexistent with those of *atropalpus*. This species is a rather late one to develop, appearing in early to mid-June, after some of the other common species, particularly *punctor*, have emerged. Fortunately, adults are not especially aggressive. This species is unusual in that hatching in spring is irregular, and not all eggs laid by the first generation of females enter an obligatory diapause, that is a built-in resting stage that carries them through the summer and following winter. Thus hatching may occur in mid-summer, and adults may be around for longer periods than many other species.

Aedes cantator (Coquillett). This infamous species, the salt-marsh mosquito, is a scourge in many parts of the Maritime Provinces and along the Atlantic Coast of USA. Fortunately for Cape Breton Highlands National Park there are few suitable salt-marshes in the vicinity, and the species is evidently not common, for only a single female was collected at South Harbour. Larvae of *cantator* require salt-marsh pools that are flooded by sea water only by extra-high spring and fall tides, but which are not affected by normal tide levels during summer, when larvae are developing. Such pools, often teeming with thousands of larvae even though they may be only a few meters in diameter, are enriched with masses of rotting sea weed by these high tides. High water table and lack of regular drainage to the sea prevents loss of nutrient material and prevents access by sticklebacks or other fish, which would consume the larvae. Periodic dilution by rain water reduces salinity to the point where the larvae are developing in virtually fresh water. In contrast, pools flooded daily, or which have regular connections to the sea, usually contain no larvae, probably because of the presence of fish, but possibly also because of too high salinity. No suitable pools were found in or near the Park, although the Cheticamp area may contain some.

Aedes communis (De Geer). This widespread species, common throughout the forested regions of the Holarctic Region, develops early and adults were the only life forms collected in the Park. Eggs can hatch before the ice has melted from the woodland pools, and are apparently not adversely affected by being covered with ice again. Larvae grow quickly, forming pupae by the time the deciduous trees are breaking into leaf. On warm days, larvae have the peculiar habit of grouping together at the surface in large aggregations. This species favours pools in deciduous woods, especially if underlain by clay, as are found in bottomlands, among alders and willows. In more acid pools, associated with conifers, such as are found in boggy situations throughout the Park, *punctor* replaces *communis* as the most common species.

Aedes decticus Howard, Dyer & Knab. Although widespread, this species is usually rare. In Canada the larvae have been found only in small, shallow, acid pools in open bogs. Only one adult was collected in the Park, along the Jack Pine Trail, in early July.

Aedes fitchii (Felt & Young). Only a single female of this species was collected, near Dingwall. Larvae have been found in a wide variety of habitats, but may be found most often in cattail marshes. The species is seldom common, and is not an important biting pest.

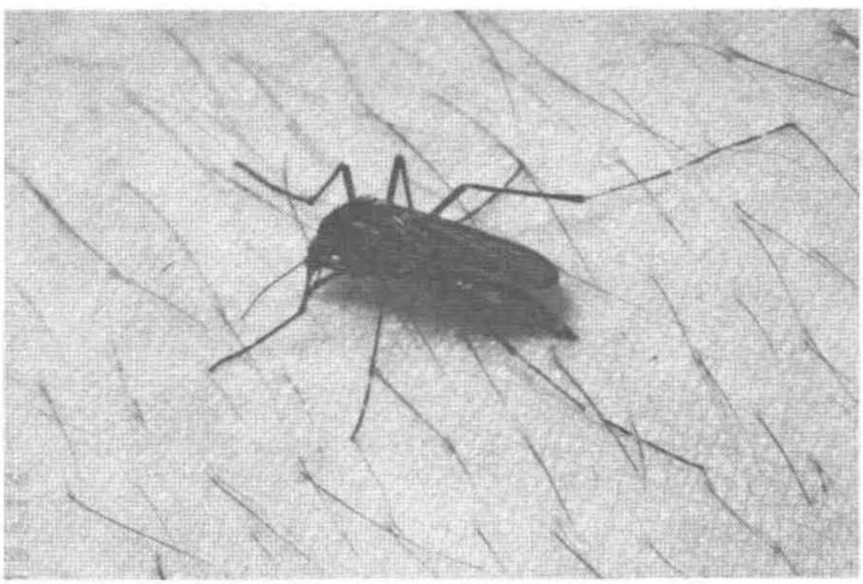


Fig. 5. *Aedes* sp. possibly *fitchii* Felt & Young, ♀. Several large common species of *Aedes*, distinguishable only by microscopic structures, could occur in the Park.

Aedes intrudens Dyer. As its name implies, adult females of this species seem unusually adept at entering buildings through openings too small to admit other mosquitoes, and they have even been observed squeezing through screens. Larvae are usually associated with those of *communis*, but are not nearly as common.

Aedes punctor (Kirby). Throughout most of the northern coniferous forests that make up the Boreal Forest Zone stretching across Canada, *punctor* is perhaps the most common species. Eggs hatch early, before the ice has fully melted, and the young larvae can probably tolerate being covered with ice at night. Larvae develop in cold bog pools, especially in those with a high tannin content which are usually strongly acidic.

Wyeomyia smithii (Coquillett). Because of its unusual life cycle, and because females of this species do not take blood, this species is the most interesting mosquito in the Park. Larvae occur only in the water contained in the leaves of the pitcherplant, *Sarracenia purpurea*, where they feed on the detritus accumulated in the leaves. They can be found in the leaves at all times of the year, and even overwinter in this situation as third instar larvae, often becoming solidly frozen into the ice in the bottom of the pitcher. Some snow cover is necessary, however, for larvae cannot tolerate subzero temperatures for long periods. Increasing temperature and day length in spring allow the larvae to resume development, and adults appear in midsummer. In Cape Breton, there is probably only a single generation per year, though two have been reported in Southern Ontario. Although females do possess mouthparts that appear capable of piercing skin, they have never been observed sucking blood from any organism. Both males and females stay close to the bog surface, and seldom stray far from their pitcherplants. Eggs are laid at night inside dry, newly opened pitcherplant leaves. They hatch when rainwater begins to collect in these leaves.

Family Thaumaleidae.

Adults of *Thaumalea americana* Bezzi, the only Eastern Canadian member of this small rare family, were collected in the vicinity of seepages in two localities in the Park, near Beulach Ban Falls, and along the south side of the Cabot Trail on its westward descent to Pleasant Bay. Larvae live in the seepages in a thin film of flowing water, feeding on algae growing on the vertical rock surfaces. Pupae are formed under overhanging ledges beside the seepages, and adults apparently do not stray far from these breeding grounds, for they have only been collected in their vicinity. Adults resemble brownish black-flies, but do not bite. Discovery of members of this family in Cape Breton was unexpected, as they had not previously been taken in the Maritime Provinces. During future reconstruction of the Cabot Trail, some effort should be made to avoid disturbing the seepage area described above.

Family Simuliidae (black-flies).

In spite of an abundance of running water, which black-flies require for breeding, Cape Breton did not seem overly afflicted with them. In comparable areas of Labrador and Quebec, outdoor activities can be almost impossible during July because of vast numbers of crawling and biting females. Of the more than 100 species that have already been found in Canada, less than a dozen species are known to bite man, and even fewer are serious pests. The remaining species either prefer to bite birds or large mammals such as moose, or do not feed at all and develop their eggs autogenously (i.e., without a blood meal).

Larvae of all black-flies require flowing water in which to develop. Some species may be found only in large rivers, others only in tiny trickles. The rate of flow is also important, for certain species occupy fast flowing water, others occur in water flowing so slowly that it appears stagnant. Larvae require flowing water in order to feed; on either side of their head are a pair of labral fans, extended in the current to capture minute particles such as algae or detritus. Each fan is an outgrowth of the labrum, or upper lip, and is homologous with the labral brush of a mosquito larva, which also feeds on particles. Such feeding is referred to as filter-feeding. To feed, a black-fly larva extends both cup-shaped fans into the current, closing each fan alternately every few seconds. Any particles captured by the fans are removed from them by brushes and combs on the mandibles and other mouthparts, and are ultimately directed into the mouth. Larvae seem unable to feed selectively, but ingest any particles of a suitable size, rejecting only those too large to manage. This inability to be selective renders them susceptible to particulate insecticides, which though difficult and expensive to formulate, are quite effective and selective for black-fly larvae.

In order to maintain their position in the current, black-fly larvae use their salivary fluid as a form of silk. This material is semiliquid in the animal but hardens immediately after it is expelled into the water. The silk is produced in the paired salivary glands, and is expressed from a minute opening at the tip of the hypopharynx or tongue. By attaching a blob, or pad, of this material to any exposed surface, such as a rock or trailing blade of grass, then grasping it with the numerous minute hooklets on their anterior or posterior prolegs, the larva is able to maintain its position in the current. To change its position, a new pad of silk is formed, grasped with the hooks on the anterior proleg, then the hooks of the posterior proleg release their hold on the old attachment site and the larva repositions its posterior end next to the anterior proleg on the new site. If disturbed, a larva can instantly attach its silk to the substrate beside it, then let go altogether, drifting downstream on a strand of silk, in much the same way that a spider can (except that spider silk is expressed from spinnerets at the posterior end of the abdomen, not from the mouth). It can then either work its way back up the strand, or reestablish itself in a new location.

Before pupating, a few species partially bury themselves in the sand or detritus on the stream bottom, and spin a few strands of silk to held themselves in place. The majority of species, however, spin a cocoon under water, attached to a suitably stable substrate. The shape and texture of the cocoon is usually characteristic of the species-group to which each belongs. The pupa breathes dissolved oxygen by means of a pair of branched, filamentous gills arising from either side of the anterior edge of the thorax. The number and arrangement of filaments usually differs from species to species; hence they can most readily be identified to species, by structural characters at least, when in the pupal stage. When the adult is fully formed in the pupa, and ready to emerge, a gas begins to build up between the adult and the pupal skin. The latter remains hooked to the interior of the cocoon. Finally the skin splits, and the adult emerges from its pupa underwater, expanding its wings as it does so, then bobs to the surface enveloped by the gas bubble. It may ride down stream a short distance before taking wing.

Adult males of most species form mating swarms, most noticable at dusk, within a day or two of emergence. Males of some species swarm alongside the stream; others emigrate to clearings in the forest, or to hilltops. Because of their small size, the swarming habits of many species remain unknown, but presumably, as with so many other Diptera, each species has its own specific requirements as to mating sites.

Once mated, the next priority of females of the biting species is to find a source of nectar, for sugar, and a source of blood, for protein, to aid in egg development. It is this need for blood, and a willingness to attack man in search of it, that makes a few species of black-flies one of the worst scourges of the North. The female does not really remove a piece of skin, but slashes a minute wound in the skin with the mandibles, which act as a pair of scissors. The maxillae, which have recurved teeth at their apices, help to stabilize the fly while the mandibles are slashing the skin. As blood wells up in the wound, the fly imbibes it until its abdomen is fully distended. To prevent coagulation, some saliva is secreted from the tip of the hypopharynx (or tongue). Blood might otherwise plug the fly's mouthparts and render them unable to complete the task. It is this minute amount of saliva, which is a protein, that causes the itchy reaction. It is perhaps interesting to note that the saliva of the larva, and that of the female, while homologous, must be quite different in chemical structure, and certainly serve quite different functions.

Unfortunately, female black-flies are not nearly as easily repelled with diethyl toluamide (DEET) as are mosquitoes. When they are particularly numerous, it is often necessary to wear either a head net or a parka-like jacket made of netting and impregnated with DEET. Development of a better black-fly repellent is much needed. Use of any repellent, however, can be augmented to a considerable extent by the wearing of light-coloured clothing (see below under *Simulium venustum*).

Fortunately, no Canadian species of black-fly transmits disease organisms to man, though some bird biting species are essential intermediate hosts for several species of blood parasites of the genus *Leucocytozoon*. These parasites, relatives of malaria, invade the red blood cells, as well as those of the spleen and other organs, causing malaria-like symptoms in birds, and the disease is frequently fatal. Efforts many years ago to introduce domestic geese at Fort Chimo, Quebec were futile because of failure to recognize the importance of endemic *Leucocytozoon* and its virulence in the area.

Oviposition must take place in a stream suitable for larval development, for the eggs cannot withstand desiccation and the newly-hatched larva is capable only of downstream dispersal in the stream in which it was hatched. Females of some species oviposit over flowing water while in flight, dropping eggs singly which sink to the bottom and become lodged among rocks and other bottom debris. Others deposit a single egg at a time on water-splashed rocks while in flight, or settle on trailing vegetation to deposit an egg mass at the edge of the water.

Most species of black-flies in Canada are univoltine, i.e., they complete only a single generation per year. Either the larva hatches in the fall and grows slowly throughout the winter to pupate and emerge in spring, or the egg remains in diapause (resting stage) throughout the summer fall and winter, to hatch in spring. In the latter instance, larval development is much more rapid, and pupation usually takes place only a week or two later than in those species which spent the winter growing as larvae. A few species are multivoltine, i.e., they can complete more than one generation per year; thus adults may be present throughout the summer and even fall. None of this latter group appeared to be represented in the Park.

The taxonomy of black-flies is complicated by the knowledge that many presumed "species" actually consist of more than one reproductively isolated species which cannot be distinguished except by study of the banding patterns of the giant chromosomes found in the salivary (or silk) glands of the larva. Study of these chromosomes not only reveals distinctive banding patterns, and other chromosomal rearrangements, but most importantly, can demonstrate whether hybridization has occurred or not. Among several of the most common "species" collected in the Park, the presence of more than one reproductively isolated entity has already been demonstrated in other areas of Eastern Canada, and may be assumed to occur in the Park as well.

Prosimulium fuscum-mixtum complex. The earliest black-flies to appear in spring, coincident with the bursting of buds of sugar maple, belong to one or both of these two species. The two species are dark brown, with paler, more orange-brown legs, which lack white patches. The two species are indistinguishable externally, and can be separated from each other only by a study of their salivary chromosomes, or by electrophoretic protein separation. Both species are avid biters of man and other mammals, and when abundant can ruin many an otherwise pleasant spring day. They bite freely on exposed skin, and seem particularly partial to the arms and hands, in contrast to the other biting species, *Simulium venustum* Say, which likes to crawl under clothing and into hair. Fortunately their season, as adults, is short, lasting only about three weeks. When the two species occur together, *P. fuscum* Syme & Davies is the earlier species to emerge. It differs from *P. mixtum* Syme & Davies in being autogenous in its first cycle, i.e., females of *fuscum* do not require a blood meal to mature their first batch of eggs, but do require blood for each successive batch of eggs. In contrast, females of *mixtum* require blood for the first as well as each successive egg batch. Thus, females of both species begin to seek blood at about the same time. Many females of one or both of these species were collected in the Park, but the specialized techniques and equipment to distinguish between them were not available, so we cannot be sure which one was present.

Simulium aureum Fries. In North America there are at least five reproductively isolated, "true" species included under this name. None of them is the true *aureum*, which is a species confined to the Old World. All five differ in the arrangement of banding of their salivary chromosomes, yet only a few, slight morphological differences have been detected between some of the five North American species. A detailed study of the complex is greatly needed to determine which names should apply to each species and how or if they can be separated morphologically.

Larvae were found in a small slowly-flowing tributary of the Cheticamp River. They like warm water, and develop rather late in the season. There are probably several generations throughout the summer, provided there is enough rainfall to prevent their streams from drying up. Adults do not bite humans or other mammals, but feed only on birds.

Simulium corbis Twinn. Larvae and pupae of this species were collected from the stream flowing through Lone Shieling. The are much less common than members of the *venustum* complex, and are more localized, being confined to medium-sized to large rivers. Larvae are usually abundant where they are found. The anterior edge of the cocoon of this species is adorned with basket-weave-like loops and cross-strands of silk, giving the cocoon a distinctive appearance. There are 10 short parallel filaments in each pupal gill. Adults presumably feed on blood, but have not been recorded feeding on man; this may be, however, an artifact of misidentification. Eggs are dropped into fast-flowing water by females while in flight. They presumably overwinter among boulders on the stream bed, hatching the following spring. There is probably only one generation per year.

Simulium parnassum Malloch. A rather rare species, and one of the last to appear in the season, usually in late June. Adults are rather shiny black, especially on the thorax, and have relatively less white on the legs than have *corbis* and members of the *venustum-verecundum* complex. They also bite humans, but are usually not common enough to be a problem. Larvae were taken in a minute trickle crossing the path that follows the south side of the Cheticamp River. This trickle, decending over nearly vertical bare rock, was barely deep enough to cover the larvae and pupae, yet the water was moving quite rapidly. Both larvae and pupae were attached to the bare rock surface, and could only be removed after diversion of the flow of water. They resemble those of *venustum* in having six filaments in each pupal gill, but the thorax of the pupa of *parnassum* is not smooth, but is covered with bumps.

Simulium venustum-verecundum complex. These "species" are also complexes of several reproductively isolated species in Canada, which can at present only be distinguished by a specialist trained to analyze the banding patterns of their salivary chromosomes. At least some member species of this complex are also avid human biters, appearing in late May or early June, as the previous species of *Prosimulium* are disappearing. Females of this complex are predominantly black rather than brown, and may readily be distinguished from those of *Prosimulium* by the prominent white patches on the legs. They are primarily responsible for the major nuisance problem throughout Eastern Canada, as well as in the Adirondacks of New York State. During the day, females often fly around one's head and crawl on his clothing, but do not appear to be interested in biting. As evening progresses, however, their blood-lust increases markedly, and they crawl into any available space in an effort to find a secluded place to bite. Dark colours are much more attractive to them than pale ones; people with dark hair, or those wearing jeans or dark clothing usually have many more females attacking them than those with light-coloured hair or wearing white or yellow. Eggs of members of the *venustum-verecundum* complex are laid on trailing vegetation. Depending on the species, they may pass the summer in diapause (a resting stage) or may hatch soon thereafter to give rise to a second generation. All members of the complex overwinter in the stream, probably becoming buried in detritus on the stream bottom as the trailing vegetation rots in autumn. Eggs destined to produce the spring generation hatch in early May, about the same time that the larvae of *Prosimulium* are beginning to pupate. Larvae of the *venustum-verecundum* complex develop in a variety of streams, from small creeks draining beaver ponds, to moderately large rivers. Part of this apparent wide tolerance in habitat preference may be simply a reflection of the presence of more than one species, each of which has its its narrower range of larval habitat. Much more research is needed to clarify the details of the life cycles of each member species in the complex.

In Cape Breton Highlands, members of this complex were found in many different habitats, and collectively, they are undoubtedly the most common species in the Park.

Stegopterna mutata (Malloch). This is also a complex of at least two species in Eastern Canada, and several more in the West. In the East, the two differ in their chromosome number; the more common of the two is triploid, i.e., each individual has half again as many chromosomes as the other species, for a total of nine, or three triads of homologous chromosomes. The other species, which is extremely rare, is diploid, i.e., has the normal number of six chromosomes, in three homologous pairs. Hybridization between the two is theoretically impossible, yet the two cannot at present be told apart except by inspection of their chromosomes. It is assumed that this triploid form, which consists solely of parthenogenetically-reproducing females, arose as a hybrid between parents of two different species. The female partner presumably failed to undergo meiosis, or the normal halfing of the chromosome number prior to egg development, resulting in six chromosomes in each egg instead of only three. When fertilized, the egg would end up with nine chromosomes instead of the normal six. One of the two parent species that gave rise to the triploid line is the rare diploid Eastern species; the other parent has not been determined. Although no cytological examination was possible, we assume that the species found in the Park belongs to the triploid form.

Larvae of this species, like those of the *Prosimulium fuscum-mixtum* complex, hatch in late fall and grow slowly beneath the ice. Unlike the latter complex, however, larvae of *mutata* are most often collected in tiny, temporary, spring-run-off streams, which usually dry up during the summer. In early May, mature larvae partially embed themselves into the mud and detritus on the stream bottom and spin a loose cocoon about themselves before pupating. This burrowing habit is unusual among black-flies, and may be an adaptation to help them survive abnormal periods of drought, or premature drying up of the stream.

Family Ceratopogonidae (biting midges, punkies) (by A. Borkent).

This family of small flies forms a common element of the fauna of Cape Breton Highlands National Park. For the most part members are only seen in the aerial net of the collector but some can be found in natural concentrations. Perhaps, the most noticeable to those visiting are species of the genus *Culicoides*, the only genus of the family in the park which are annoying biters of man. In the months of June and July *Culicoides sanguisuga* (Coquillett) can occur in huge numbers. Because they are very small, these "no-see-ums" or "sand flies", can crawl or fly through the screens of tents and campers and produce an irritating bite as they withdraw a blood meal. Larvae of *C. sanguisuga* live in localized areas within the deciduous forest and, for example, were vicious biters at Lone Shieling and MacKenzie Mountain in 1984. Four other species of *Culicoides* were recorded from the Park but these are mainly feeders on birds.

Another species which can be commonly observed is a species of *Atrichopogon*. Members appear to feed on the pollen of *Nuphar* flowers when these are in bloom at the surface of lakes in the park. By looking closely, perhaps from the edge of a boat, an observer can see these small black flies crawling over the petals of the flower.

Although not common, *Forcipomyia eques* (Johannsen) can be occasionally seen as a small fly attached to the wings of the lacewing. These are all females obtaining lacewing blood for the development of their eggs.

Other species of Ceratopogonidae such as those in *Palpomyia* and *Bezzia* can be seen swarming in aquatic or semiaquatic habitats but these require detailed examination for proper identification.

The following is a list of genera collected in the park and some are further identified to species:

Atrichopogon
Forcipomyia
Culicoides atchleyi Wirth and Blanton
C. crepuscularis Malloch
C. frohnei Wirth and Blanton
C. jamnbacki Wirth and Hubert
C. sanguisuga (Coquillett)
Dasyhelea grisea (Coquillett)
Dasyhelea n. sp.
Ceratopogon (including 4 new species)
Isohelea (at least 3 new species, all probably new)

Alluaudomyia parva Wirth
A. megaparamera Williams
Brachypogon n.sp.
Serromyia n. sp.
Monohelea sp.
M. leucopeza (Meigen)
Stilobezzia stonei Wirth
Bezzia bivittata (Coquillett)
B. expolita (Coquillett)
Clinohelea curriei (Coquillett)
Palpomyia basalia (Walker)
P. walteri Grogan and Wirth
P. hastata Grogan and Wirth
P. flaviceps (Johannsen)
P. plebeia (Loew)
P. rubiginosa Grogan and Wirth
P. n. sp. near *plebeiella* Grogan and Wirth

Family Chironomidae (midges)
by M.E. Dillon and D.R. Oliver

Chironomids are one of the most important and diverse groups of aquatic insects. The family has a worldwide distribution with over 5000 described species. It is estimated that over 10,000 species exist worldwide. In Cape Breton Highlands National Park about 50 genera have been collected representing 5 of the 10 subfamilies. It is expected that the total number of species will be over 200.

Chironomid larvae are elongate, and usually cylindrical and slender. Mature larvae range in length from about 1 to 30 mm, although few are longer than 10 mm. The non-retractile head-capsule extends foreward in the same plane as the longitudinal axis of the body. Usually a pair of fleshy unjointed appendages bearing hook-like claws are present at either end of the body. Additionally the posterior end usually bears a pair of hair-tufts and 1-3 pairs of thin-walled tubules. Colour is variable but red species are known to fishermen as bloodworms. Adults resemble those of mosquitoes. Adult males have densely plumose antennae differing from male mosquitoes which have the antennal hairs arranged in distinct groups. Adult females lack the elongated biting mouthparts of female mosquitoes.

The total life cycle from egg to adult takes several weeks to several years depending upon the species, availability of larval food and oxygen, and temperature. Ninety percent of the life cycle is spent in the larval stage. Generally species emerging in the spring and early summer in north temperate regions have one generation per year whereas those emerging in the summer and fall have several generations per year.

Freshwater is the primary habitat of chironomid larvae and pupae. They also occur in saline and brackish waters and in semi-aquatic habitats such as wetlands, wet areas adjacent to water bodies, wet leaf litter, guano, in water retained by plants, tree holes and cow dung. Larvae live in or on substrate at all depths of freshwater bodies, on submerged objects such as stones, wood and plants, and in many specialized habitats -- boring in decomposing wood, mining in leaves and stems of aquatic plants, in *Nostoc* and in algal mats. Some live in close association with, or are parasitic on, mayflies, stoneflies, caddisflies, sponges, bryozoans and molluscs.

Apart from historical reasons the distribution of each of the subfamilies is governed primarily by the availability of water ecologically suited to the requirements of the larvae. The Podonominae, primarily rheophilic and cold-adapted is much commoner in the southern hemisphere than in the northern hemisphere. The Diamesinae and Prodiamesinae are also primarily rheophilic and cold-adapted, although a few species occur in still water. They inhabit the colder parts of the circumpolar lands and mountain ranges throughout the world. Most of the species in the family belong to one of the subfamilies Tanypodinae, Chironominae and Orthocladiinae. The Tanypodinae and Chironominae are essentially warm water forms living in still water but also occur in flowing water and cool habitats. Orthocladiinae are primarily cool-adapted, but are not uncommon in warm waters. They occur equally in still and flowing waters. Their larvae occupy the widest range of habitats of all chironomids and it is the only subfamily with terrestrial larvae. It is the predominant subfamily in the arctic region.

In aquatic bodies most larvae are benthic and live in cases constructed on or in substrate. Others are free-living, non-case builders that move freely throughout the water column. Most chironomid larvae feed on small plants or animals and on detritus. Diatoms are a common food source throughout the family. Most Tanypodinae and a few free-living species in other subfamilies are predaceous.

Most pupae are sedentary and are protected by some sort of a case. Others are free-living and actively swim within the water column. When the pupa is mature and upon receiving proper stimuli, it moves to the surface of the water and adult eclosion occurs. Eclosion generally takes less than one minute. Using the pupal skin as a platform the adult briefly rests to expand its wings and then flies to the nearest shore.

Emergence of adults from any given habitat, except in very uniform environments, is not a random occurrence but has a very definite phenological sequence. Each species has a more or less restricted period of emergence with less intensive emergence before and after a peak. In warm habitats, emergence can occur throughout the year. Towards higher latitudes, the larvae spend more time overwintering, and the emergence period becomes shorter. In the arctic region it is very short and highly synchronized and the same is generally true of spring emerging species in north temperate regions.

One of the most frequently seen activities of adult chironomids is the swarming of males. The "dancing" males assemble above some specific marker that contrasts with the general background. Swarms, depending upon the species, are usually most evident at dusk near margins of water bodies and sometimes number many thousands of individuals. A single swarm is composed of only one species. At times they resemble columns of rising smoke. The swarms bring the sexes together for mating. Females attracted by the swarming males are soon mated. A few species have lost the swarming habit and mating occurs on some substrate. It has been generally assumed that adult chironomids do not feed but there is increasing evidence that many species feed on honey dew or plant exudates.

Chironomids often occur in large numbers. Larval densities over 30,000/ m^2 are not uncommon in rich aquatic habitats. Adults emerging from such habitats can attain nuisance proportions in warm climates and some people develop allergic reactions to the decomposing adults. Such occurrences are rare in eastern Canada but as waters are increasingly enriched and impounded an increase in the frequency of such occurrences is expected.

Chironomid larvae are important in the breakdown and recycling of nutrient materials in aquatic ecosystems. They provide food for many species of fish and other invertebrates. Adults are an important source of food for many birds and some insects such as dragonflies.

A large number of different habitats suitable for chironomid larvae occur in the Cape Breton Highlands National Park. Only springs, seepage areas and first order streams associated with these were investigated during a two week period in June, 1984. Chironomids of these habitats are poorly known and the specimens obtained are a valuable addition to the Canadian National Collection. Most of the species belong to the subfamily Orthocladiinae. One genus and about 10 species new to science, were collected. Among the described species there were a number of significant range extensions including new records for North America and for Canada.

Parasmittia carinata Strenzke has been previously recorded only from central Europe. The occurrence of the genera, *Doithrix* and *Psilometriocnemus*, are new Canadian records. As are the species, *Conchapelopia rurika* (Roback), *Limnophyes cristalissmus* Saether, *Pseudorthocladius villosa* Saether & Sublette, *Pseudorthocladius wingoi* Saether & Sublette, and *Stilocladius clinopectens* Saether. *Boreochlus persimilis* (Johannsen), *Conchapelopia cornuticaudata* (Walley), *Heleniella hirta* Saether and *Macropelopia decedens* (Walker) have not been previously recorded east of Quebec in Canada. Several species, *Diplocladius cultriger* Kieffer, *Limnophyes borealis* Goetghebuer, *Limnophyes hudsoni* Saether, and *Prosmittia nanseni* (Kieffer) are widespread in Canada including the arctic region.

Acknowledgement

We wish to thank Dr. P.S. Cranston, British Museum (Natural History), London, for assistance in identifying some of the specimens.

Suborder Brachycera

Former classifications of the Diptera divided the Brachycera (in the sense in which it is used here) into two suborders, Orthorrhapha and Cyclorrhapha. The Orthorrhapha is here treated as two infraorders, Tabanomorpha and Asilomorpha, each with several families in Cape Breton Highlands National Park. The former Cyclorrhapha, now called Muscomorpha, contains about forty families in the Park.

Infraorder Tabanomorpha

Family Tabanidae (horseflies and deerflies) (by H. J. Teskey).

The Tabanidae is one of the four major families of blood-sucking flies; the others being Culicidae (mosquitoes), Simuliidae (black flies) and Ceratopogonidae (biting midges or no-see-ums). Species of Tabanidae are medium to large in size, often distinctively and colourfully marked, with a stocky body, head much wider than thick, with antenna having the terminal segments progressively smaller (stylate) and not hair-like, and with the third segment usually much longer and wider than other segments, and the wing with 10 or 11 veins reaching the margin.

The common names, given above, are the most widely used and apply to the two major groups of the family. Horseflies include the genera of larger species, mainly *Hybomitra* and *Tabanus* (subfamily Tabaninae), that in the days of horsepower caused these animals considerable irritation often to the greater irritation of the persons riding or driving the horses. The name deerflies refer to the smaller patterned-winged *Chrysops*. This name is probably not to imply a greater preference for deer, but rather to denote their relative diminutive stature.

Horseflies and deerflies are indeed a severe problem to man and animals in many parts of Canada, particularly in forested areas having abundant standing water. Thus, it was rather a surprise not to find them annoying in Cape Breton Highlands National Park. At only a few times during the two years of the survey were any of the survey party especially aware of harassment by these flies. This is probably due to the generally well-drained nature of the mountainous terrain with the primary water being relatively fast flowing streams draining the highland bogs and lakes. The latter mostly have rather clean margins without the shallow marshy shores in which many tabanid larvae breed. Bogs have a very distinctive but rather restricted fauna of Tabanidae but do not seem to produce high populations. There are few woodland marshes and swamps or semi-swamp-like portions of streams in which most pest species of Tabanidae breed. The minor annoyance that was voiced was from those persons working in the delta area of the Cheticamp river where such marshy conditions did occur.

The life cycle of Tabanidae begins with their mating. Males prepare for this act by station-taking, either resting in conspicuous places or hovering where females fly to be chased and caught by the males followed by coupling and insemination. The type of resting sites or hovering locations and the time of day of these activities are rather distinctive of the species. Egg development is dependent on the female having adequate nutritional reserves. Such reserves were initially thought to be totally dependent on the female having taken a blood meal. It is now recognized that quite a number of species emerge from the pupa with an excess supply of fat deposits sufficient for the development of the first batch of eggs. However, successive egg batches can only be produced after blood meals.

Eggs are laid, depending on the species, in single or multi-tiered masses of from 50 to 400 eggs, on leaves or branches overhanging water or wet soil. Following an incubation period of one to two weeks, the young larvae hatch and fall to the wet substrate where they burrow into the wet soil and feed on microorganisms and other invertebrate larvae. Growth to full size usually takes a year, sometimes more. Mature larvae migrate to a dryer but still damp site that is unlikely to be submerged, where they pupate near the surface. In one to two weeks the adult emerges.

The thirty-nine species of Tabanidae that were found or are likely to be found in Cape Breton Highlands National Park are listed below. I am indebted to Dr. G.B. Fairchild Baddeck and the University of Florida, Gainesville for providing a list of his collections in Cape Breton from which the species potentially in the Park were drawn. The latter, marked by an asterisk, were all collected no farther from the Park than Baddeck.

Chrysops ater Macquart
calvus Pechuman & Teskey
carbonarius Walker

cuclux Whitney
excitans Walker
frigidus Osten Sacken
fuliginosus Wiedemann
lateralis Wiedemann
mitis Osten Sacken
niger Macquart
shermani Hine*
sordidus Osten Sacken
vittatus Wiedemann*
zinzalus Philip*
Haematopota rara Johnson
Atylotus hyalicosta Teskey*
palus Teskey*
sphagnicola Teskey
thoracicus Hine
Stonemyia tranquilla (Osten Sacken)

Tabanus catenatus Walker
marginalis Fabricius
nigrovittatus Macquart
vivax Osten Sacken
Hybomitra affinis (Kirby)
astuta (Osten Sacken)
epistates (Osten Sacken)
frontalis (Walker)
frosti Pechuman*
lasiophthalma (Macquart)
longiglossa (Philip)*
lurida (Fallen)
microcephala (Osten Sacken)*
minuscula (Hine)
nuda (McDunnough)
pechumani Teskey & Thomas
trepida (McDunnough)*
typhus (Whitney)
zonalis (Kirby)

The most commonly collected species were *Hybomitra pechumani*, *H. typhus*, *H. epistates*, *H. nuda*, *Chrysops excitans*, *C. ater* and *C. calvus*. Of these, the first two are known to breed in bogs and were collected as larvae in the French Lake bog. *Hybomitra typhus* seems to be restricted to breeding in bogs, whereas larvae of *H. pechumani* have also been found in woodland swampy habitats. Other species also apparently restricted to bogs are *Hybomitra frosti*, *H. longiglossa*, *H. minuscula*, *Atylotus palus*, *A. sphagnicola*, *A. thoracicus* and *Haematopota rara*. The latter species, true to its name, is very rare with about sixteen collection sites known in eastern North America, with most yielding only one or a few specimens. Only three species of *Chrysops (frigidus, excitans and niger)* are known to breed in bogs but none of them solely in bogs.

Larvae of most species are found only in fresh water habitats. However there are two species in the Cape Breton fauna that breed in coastal salt marshes, *Tabanus nigrovittatus* and *Chrysops fuliginosus*. The former, often commonly called the green head fly because of its brilliant green eyes with a narrow transverse dark stripe, is found along much of the Atlantic seaboard. In coastal areas of the United States where very extensive saltmarshes are common, this species can be an almost intolerable nuisance to people vacationing on adjacent sand beaches. However, with the mainly rocky coast of Cape Breton Highlands National Park, salt marshes are nearly absent as are the potential problems from these flies. Both species are near their northern distributional limit in the Park.

The species of Tabanidae that were found in the Park presented no surprises except for *Tabanus catenatus* Walker. This is one of the largest species of horseflies, at 19-25 mm. long and is a new record for Cape Breton. There are only three other specimens known from the Maritime Provinces.

In conclusion, the tabanid fauna of the Park provides fine examples of the variety of colour pattern and form without the excessive populations that could cause severe discomfort to Park visitors.

Family Rhagionidae (snipe flies).

With the exception of members of the genus *Symphoromyia*, snipe flies are not blood sucking. Although rather closely related to tabanids, most adult snipe flies are slender, and resemble therevids and robber flies more than tabanids. Six species were collected in the Park. One species of *Symphoromyia*, probably *hirta* Johnson (the genus needs taxonomic revision), was collected in the Park, although in such low numbers that it probably is not a significant biting pest. In most parts of Western Canada, and in a few places in southern Ontario, members of this genus swarm around peoples' heads or crawl on their exposed flesh, often biting like deer flies. Three species of the genus *Rhagio*, *R. vertebratus* (Say), *R. gracilis* (Johnson), and *R. mystaceus* (Macquart), were also collected. Males of all three species may be seen in early summer resting on leaves or on tree trunks in deciduous woodland. The most commonly collected species, *R. mystaceus*, has a mottled wing pattern of brown and white which helps to camouflage them while resting on the bark of trees. The other two species are much paler, with yellowish abdomen and transparent wings. Two species of *Chrysopilus*, *C. proximus* (Walker) and *C. quadratus* (Say), were less common; they are much smaller than members of *Rhagio*. Larvae of rhagionids are believed to be predaceous and are quite similar to those of tabanids. They also live in the soil.

Family Stratiomyidae (soldier flies).

Adult soldier flies come in a variety of colours, shapes and sizes, and a few species resemble bees to some extent. Six species were found in the Park; all of them are apparently new records for Nova Scotia. Most adult stratiomyids, especially the largest species belonging to the genus *Stratiomys*, are yellow and brown; one species, *S. lativentris* Loew, occurs in the Park. The other species of stratiomyids collected are much smaller and most are partly or wholly metallic green. *Sargus decorus* Say is a medium-sized species, easily distinguished by its long slender form and entirely metallic green coloration. Two species of the genus *Beris*, *B. fuscipes* Meigen and *B. strobli* Dusek and Roskosny, and two of *Allognosta*, *brevicornis* Johnson and *fuscitarsis* (Say), are the smallest species taken. Larvae of *Stratiomys* live in aquatic or semiaquatic habits, crawling out of the water to pupate. The cuticle of many aquatic species is quite tough, being made of chitin impregnated with calcium carbonate. Larvae of the other stratiomyids are terrestrial, living in a variety of habitats containing decaying vegetation. Most are vegetarian, but some, especially those living under the bark of dead trees, are predaceous. The pupa of all members of the family is formed entirely within the last larval skin, after the larva has concealed itself in a safe place. To escape, the adult must rupture this larval skin. This condition is universal among the Muscomorpha, but among other Diptera it is unique to the Stratiomyidae and the Xylomyidae.

Family Xylomyidae.

The first record for the Maritimes, a single specimen of *Macroceromys tenthredinoides* (Wulp) was collected at Lone Shieling on July 1. Larvae of Xylomyidae are quite similar to those of the preceding family; they live under bark and the pupa is formed inside the last larval skin.

Family Xylophagidae.

Adults of this family are rather wasp-like, and strongly resemble members of the hymenopterous family Ichneumonidae. Four species of *Xylophagus* were collected; all look very much alike in the adult stage. *X. reflectens* Walker was the most common; the others were *X. cinctus* (De Geer), *X. lugens* Loew and *X. nitidus* Adams. The latter species has apparently not been previously recorded from Nova Scotia. Larvae of Xylophagidae, as the name implies, burrow in rotton wood; they are thought to be predaceous. Unlike the previous two families, the pupa is not retained inside the last larval skin.

Infraorder Asilomorpha

Family Asilidae (robber flies).

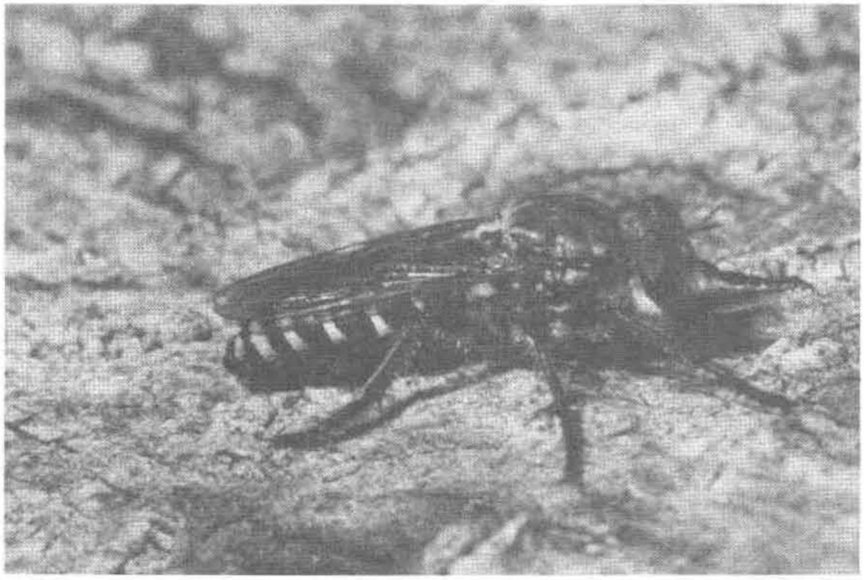


Fig. 6. *Cyrtopogon lutatius* (Walker) probably ♂.
One of the commoner species in the Park, *C. lutatius* was among about six species of *Cyrtopogon* collected there. Both sexes wait for their prey on bare ground.

Six families of this infraorder were collected in Cape Breton Highlands National Park. The larvae of all of them are believed to be predators, or are external or internal parasites.

Members of this large family are among the most conspicuous in the infraorder. Although Eastern Canadian species are modest in size, some in the southwestern U.S.A., in Australia and in other desert countries, are among the largest known flies, being over 5 cm in length. Adult robber flies are rapacious predators, seizing their prey in flight and injecting it instantly with a paralyzing dose of salivary secretion injected via the syringe-like tongue (hypopharynx). The saliva contains neurotoxic and proteolytic enzymes; in a relatively short time the contents of the prey become liquified and can be sucked out by the robber fly. Unlike the blood-sucking flies, in which only the female bites, both sexes of robber flies take prey, apparently with equal frequency. Prey varies from species to species; the small slender species of *Leptogaster* hunt for stationary prey, picking off aphids and other small insects, much as do damselflies. Most other robber flies select a particular perch, at a natural vantage point commanding a good view of a clearing, and chase potential passing prey using their eyesight. A few species of asilids regularly capture stinging insects such as bees and wasps; either they are not affected by the stings or they inject their saliva so quickly that the bee has no time to sting. Members of the genus *Laphria* are the largest robber flies in Cape Breton; most of them mimic bumble bees. When hunting, they rest on bare, sunlit logs. It is presumed that their bumble bee-like appearance renders them less attractive to even larger predators, such as dragonflies, but it may also serve to fool passing female bees into thinking they are being accosted by a male bee rather than a malicious predator. There are many instances, in other countries, of robber flies resembling their prey rather closely, possibly enabling them to approach and capture them more readily, or to approach their nests without being attacked themselves. Larvae of all robber flies are assumed to be predaceous when older; some may be ectoparasitic during their early instars on larger immobile larvae. For example, young larvae of the robber fly genus *Proctacanthus* are ectoparasitic on white grubs, the larvae of June beetles. Larvae of *Laphria* are usually found in rotten wood, and may also attack scarab or long-horned beetle larvae living in the wood.

Family Therevidae (stiletto flies).

Therevids look like small robber flies but lack their rapacious habits. Males of several species that occur in sandy areas are silvery coloured, especially on the abdomen, and are difficult to see as they fly from place to place over the bare sand. Therevid larvae are exceptionally long and slender, and burrow through loose sand or soil in search of prey.

Family Bombyliidae (bee flies).

Members of this family are quite conspicuous, not only because of their bright colours and patterned wings, but because of their habit of resting or hovering in bright sunlight over woodland paths or bare ground. A few species are among the first flies to appear in spring; *Bombylius major* Linnaeus (which has the basal half of the wing brown) and *B. pygmaeus* Fabricius (which has additional small brown spots on the clear portion of the wing) may

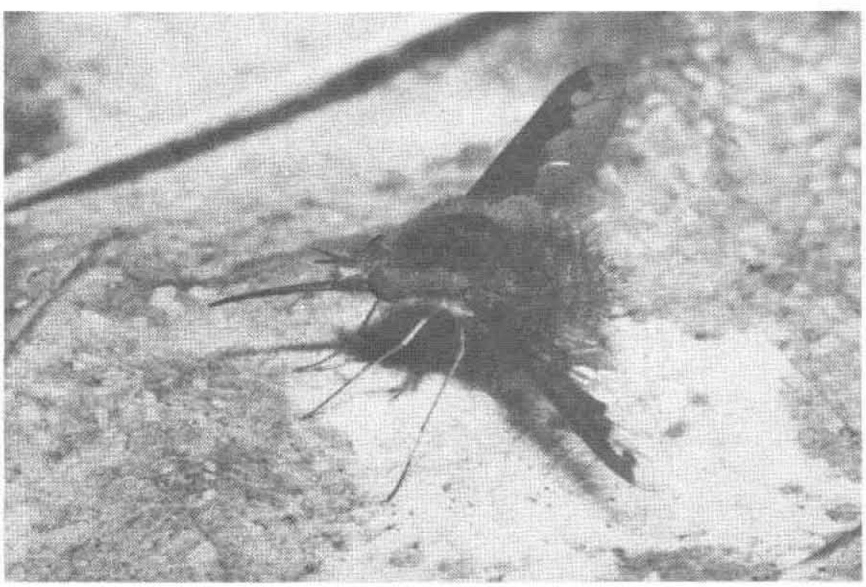


Fig. 7. *Bombylius major* Linnaeus. One of the earliest flies to appear in the spring, this species is frequently seen hovering over bare patches of sand along roadsides.

be seen alighting on bare earth, or hovering over sandy roadsides. Specimens of both species were collected in early June at Pleasant Bay and at other localities. Females carry sand in a special pouch at the end of the abdomen; the sand is then used to coat the eggs as they are laid. The eggs are then fired here and there in places where the hatching larvae possibly will find suitable hosts. Later in summer, various species of the genus *Villa* replace those of *Bombylius*. Three species of *Villa* were collected in the Park. The most common, *V. lateralis* (Say), with transparent wings and a black and yellow transverse striped abdomen, occurs throughout the area, especially in spruce forest. A single specimen of a minute bombyliid belonging to the genus *Glabellula* was collected in a dry locality of *Vaccinium* and *Sphagnum* in a barren; the only previous Canadian record of any species in this genus is from Manitoba. Larvae of Bombyliidae are internal parasites of various other insect larvae, or feed on grasshopper egg masses.

Family Acroceridae (small-headed flies).

Adults of this family have the smallest heads, in proportion to their stout bodies, of any flies. Only one species, *Acrocera bimaculata* Loew, was collected in the Park. Larvae of acrocerids develop as internal parasites of spiders. Females have been observed firing their eggs in the general direction of potential host spiders. Newly hatched larvae, called planidia, are quite active as they attempt to gain access to the host, but after they enter the host, they become maggot-like.

Family Empididae (dance flies).

Adults of both sexes of many species, as well as all larvae, are predaceous on smaller insects. A few adult empidids have even developed the ability to steal carrion from the webs of spiders. The swarming and mating habits of many species of Empididae are quite complex and ritualistic, and have given rise to their common name. Prey is captured by the male and subsequently presented, uneaten, to the female, possibly to divert her carnivorous instincts long enough for him to mate with her. The female may not hunt at all, depending, instead on the prey provided by the male, a behaviour analagous to that found in gyrfalcons and peregrines. Some species of empidids encase their prey in a frothy mass secreted by the male; in the most highly derived behaviour the frothy mass alone substitutes for the prey. A substantial number of species of empidids were collected in Cape Breton, but because the taxonomy of the group is not well known, it is not possible to give an estimate of the number of species that occur there. In early summer empidids may be found almost everywhere, swarming at all levels in the forest, or skimming rapidly over the surface of every body of water, even puddles on dirt roads, presumably in hopes of capturing midges or mosquitoes emerging from the water. Unlike swarming Nematocera, in which only males swarm and females come to the swarm only to mate, female empidids of some species may swarm while males of the same species are out hunting for prey among the male swarms of midges or other insects.

Family Dolichopodidae (long-legged flies) (by B.M. Bissett).

The family Dolichopodidae is one of the largest in the Diptera comprising about 150 genera and 6,000 species worldwide. They are small slender flies 0.8 to 9 mm long. Often they are partly or entirely metallic green or blue, but they also may be yellow, brown, or black. Habitat data have been recorded for few of the described species. Many conspicuous members of the family are commonly found in moist to wet sunny locations. Other species are found in a variety of habitats, and a few are known only from marine shores. Habitat preference in some genera is probably related to mating; females of these genera position themselves in specific locations where males will hunt for them.

Many species display sexual dimorphism. The males have complex genitalia as well as modified body parts to attract mates. The legs, wings, antennae or other structures may be displayed to the female during courtship. There are other less conspicuous sexual differences such as the outline of the posterior margin of the wing and modifications of the posterior surface of the hind tibia, but the significance of these is not known.

In most species, adults of both sexes are thought to be predaceous on other insects and arachnids. Some larvae are known to feed on immature insects. Larvae of the genus *Thrypticus* are leaf miners. Adults of *Hydrophorus* "skate" on the water, feeding on dead insects floating on the surface. Other species have been reported to feed on newly emerged insects at the edge of water. Adults of *Dolichopus* are known to prey on mosquito larvae.

Dolichopus is the largest genus in the family with about 300 described North American species, and many more undescribed. At least 120 species of *Dolichopus* have been reported from Canada east of Manitoba. Forty species are known from New Brunswick, and of these, 36 were collected in Kouchibouguac National Park in 1977/78. There are 51 species known from Nova Scotia, and 38 species were taken in Cape Breton Highlands Nat. Park in 1983/84. Of these 38 species, 12 are new to Nova Scotia. Four species are additions to the known fauna of the Maritime Provinces, and three were previously unknown in Canada. Besides *Dolichopus*, twenty-three other genera and 50 species were identified from the Park. Numerous species of *Chrysotus* were collected but cannot be determined at the present time.

Although boreal species from other groups including Syrphidae, Scathophagidae, and the dolichopodid genus *Hydrophorus* were taken in the Park, particularly from North Mountain, none of the many known boreal species of *Dolichopus* was collected there. Almost all of the species of *Dolichopus* collected in C.B.H.N.P. have ranges that extend far to the south. A notable exception is *Dolichopus footei* Harmston, which was previously known only from Idaho. Several species of other Dolichopodid genera are apparently new to Canada.

Appended is a list of species of Dolichopodidae from the Park that have been identified to date. Also included is a chart showing, for each species, the number of specimens collected in Cape Breton Highlands N.P., habitat and locality data for these collections, and what the B.R.I. holdings previous to the survey. Literature reports on distribution are summarized in the chart and new records resulting from the survey are reported.

Species List: Cape Breton Highlands National Park
Family Dolichopodidae

Argyra fasciventris Van Duzee
Asyndetus ammophilus Loew
Calyxochaetus fortunatus (Wheeler)
frontalis (Loew)
Campsicnemus degener Wheeler
hirtipes Loew
wheeleri Van Duzee
sp.
Chrysotus spp.
Condylostylus nigrofemoratus (Walker)
Diaphorus sp.
Diostracus prasinus Loew
Dolichopus adultus Van Duzee
aequalis Van Duzee
agronomus Melander & Brues
barbicauda Van Duzee
brevimanus Loew
canadensis Van Duzee
coercens Walker
cuprinus Wiedemann
defectus Van Duzee
demissus Van Duzee
dorycerus Loew
flavilacertus Van Duzee
footei Harmston
fulvipes Loew
gaigei Steyskal
genualis Van Duzee
harbecki Van Duzee
johnsoni Aldrich
lobatus Loew
melanocerus Loew
nigricornis Meigen
nubifer Van Duzee
ornatipennis Van Duzee
ovatus Loew
palaestricus Loew
plumipes (Scopoli)

pugil Loew
remipes Wahlberg
scoparius Loew
setifer Loew
? *sicarius* Van Duzee
sincerus Melander
socius Loew
splendidulus Loew
subdirectus Van Duzee
trisetosus Van Duzee
variabilis Loew
n.sp.
Gymnopterus annulatus Van Duzee
currani (Van Duzee)
difficilis Loew
frequens Loew
humilis Loew
nigribarbis Loew
scotias Loew
subdilitatus Loew
? n.sp.
Hydrophorus chrysologus (Walker)
philombrius Wheeler
n.sp.
Medetera veles Loew
sp.
Micromorphus sp.
Millardia intentus (Aldrich)
Neurigona arcuata Van Duzee
disjuncta Van Duzee
maculata Van Duzee
Parasyntormon rotundicorne Van Duzee
Pelastoneurus abbreviatus Loew
Peloropeodes brevis (Van Duzee)
Rhaphium armatum Curran
brevilamellatus Van Duzee
furcifer Curran
punctitarse Curran
signiferum (Osten Sacken)
sp.
Scellus exustus (Walker)
Syntormon n.sp.
Tachytrechus binodatus Loew
moechus Loew
Thinophilus ochrifacies Van Duzee
sp.
Thrypticus sp. a
sp. b
sp. c
sp. d
sp. e
frateculus (Wheeler)

Name	Specimens Collected In CBHNP	Total Specimens Previously In CNC	Dates Collected In CBHNP	Distribution	Habitat	Locality	Comments
Argyra fasciventris	1 ♂, 4 ♀	1 ♂, 1 ♀	22.VI.-7.VII.83	Conn.	damp sphagnum fen dry mixed forest	North Mountain 400 m Mary Ann Falls Rd.	
Asyndetus ammophilus	12 ♂, 6 ♀		29.VI.-11.VII.83	Mass to S.C.	dry sand beach ridge with Ammophila & mixed plants mixed dry mesophytic woods	S. Harbour	
Calyxochaetus fortunatus	2 ♂, 1 ♀	11 ♂, 5 ♀	8.VII.-18.VII.	Ont. to Maine, s. to N.C.	swept along fast rocky stream	Beulach Ban	
Calyxochaetus frontalis	1 ♂, 1 ♀	4 ♂, 4 ♀	10.VII.	Iowa to Maine, s. to Tenn. & N.C.	dry marsh, very mixed vegetation	Bay St. Lawrence	
Campsicnemus degener	1 ♂	75 ♂ + ♀	29.VI.83	Alaska, Wash. to Calif. and Colo. Ont., Que.	mixed dry mesophytic woods	S. Harbour	
Campsicnemus hirtipes	1 ♂, 2 ♀	49 ♂ + ♀	29.VI.-11.VII.83	Kans. to Mich. and Que., s. to Fla.	mixed dry mesophytic woods swept along fast rocky stream	S. Harbour Lone Shieling	
Campsicnemus wheeleri	2 ♂, 2 ♀	3 ♂ + ♀	23.VI.-10.VII.83	Maine, Que.	mixed dry mesophytic woods dry marsh, mixed veg. pool margin	South Harbour Bay St. Lawrence Cp. North	
Campsicnemus sp.	1 ♀		8.VII.83		sweeping bare gravel rivershore	S. Br. N. Aspy R.	
Condylostylus nigrofemoratus	3 ♂	77 ♂, 86 ♀	6.VII.-9.VII.83	Colo. to N.S., s. to Ga.	mixed dry mesophytic woods swept under overhanging trees	S. Harbour Clyburn Brook	
Diaphorus sp.	2 ♀		10.VII.83		dry marsh, mixed vegetation	Bay St. Lawrence	

Diostracus prasinus	8 ♂, 4 ♀	7 ♂, 11 ♀	1.VII.-11.VII.83	N.Y., Vt., Mass., Va., Tenn., N.C.	along fast rocky stream wet rock face	Beulach Ban Lone Shieling, Beulach Ban	
Dolichopus adultus	7 ♂, 1 ♀	4 ♂	21.VI.-15.VII.	N.Y., Mich.,	damp sphagnum fen	North Mt. 400m	New to N.S.
Dolichopus aequalis	1 ♂	3 ♂, 1 ♀	8.VII.	N.Y., Que.		French Lk. Bog	
Dolichopus agronomus	1 ♂	4 ♂	8.VII.	Mass., N.H.		15.20 mi N. Hunter	
Dolichopus barbicauda	11 ♂, 8 ♀	39 ♂, 6 ♀	22.VI-8.VII.	B.C. to P.E.I., s. to Iowa & N.Y.	muddy roadside ditch with slight water flow mixed dry mesophytic woods damp ground with Carex wet Carex marsh sweeping Ericaceae, Carex & Scirpus riverflood plain	Dingwall S. Harbour Paquette Lake La Prairie	
Dolichopus brevimanus	10 ♂	17 ♂, 7 ♀	19.VI.-8.VII.	N.W.T., Man. to Que., s. to Wis. & D.C.	muddy roadside ditch with slight water flow marshy lake shore with brackish water mixed wood with small stream dry mixed forest	Dingwall S. Harbour Black Brook	
Dolichopus canadensis	10 ♂, 1 ♀	46 ♂, 19 ♀	18.VI.-8.VII.	Sask. to Que., s to Wyo. & Mass.	muddy roadside ditch with slight water flow marshy shore, tidal river wet hardwood forest	Dingwall Ingonish Ctr. Pleasant Bay	New to N.S.
Dolichopus coercens	2 ♀	10 ♂, 16 ♀	25.VI.-7.VII.	Middle States	marshy freshwater river shore Picea/Betula woods	Petit Etang Mackenzie Mt. 300 m.	
Dolichopus cuprinus	1 ♂	64 ♂, 26 ♀	17.VIII.	Md., N.W.T., B.C. to N.S., s. to Nev. & Va.	damp meadow	Pleasant Bay	
Dolichopus nr. defectus	2 ♂		25.VI.-7.VII.	Man. to Que., s. to Conn.	Picea/Betula woods wet hardwood forest	Mackenzie Mt. 300 m Pleasant Bay	
Dolichopus demissus	15 ♂, 10 ♀		22.VI.-8.VII.	N.Y., N.J.	damp sphagum fen slope fen	French Lake North Mt. 400 m French Mt. Bog	New to Canada

Dolichopus dorycerus	1 ♂, 3 ♀	15 ♂, 13 ♀	4.VII.	N.H. to Ga.	damp sphagnum fen	North Mountain 400 m	New to Canada
Dolichopus flavilacertus	2 ♂, 2 ♀	4 ♂, 2 ♀	4.VII.	Ont. to Mass., s. to Tenn. & N.C.	damp sphagnum fen pool margin with Typha/Juncis + fern	North Mountain 400 m Cape North	New to N.S.
Dolichopus footei	26 ♂, 32 ♀		22.VI.-11.VII.	Idaho	damp sphagnum fen	North Mountain 400 m	New to Canada
Dolichopus fulvipes	1 ♂	2 ♂	1.VII.	Alta. to N.S., s. to N.J.	damp sphagnum fen	North Mountain 400 m	
Dolichopus gaigei	1 ♂	2 ♂	8.VII.	Wash., N.B.		French Mt. Bog	
Dolichopus genualis	12 ♂, 3 ♀	28 ♂, 22 ♀	2.VI.-11.VII.	Maine, Ont., Que., Nfld.	damp sphagnum fen dry spruce/birch forest Picea/Betula woods sweeping Ericaceae, Carex & Scirpus	North Mt. 400 m Black Brook Mackenzie Mt. 300 m Paquette Lake	
Dolichopus harbecki	19 ♂, 14 ♀	23 ♂, 17 ♀	8.VII.-14.VII.	Que. & Maine to Ga.	swept along fast rocky stream seepage over rocks	Beulach Ban Pleasant Bay	
Dolichopus johnsoni	45 ♂, 18 ♀	3 ♂, 6 ♀	22.VI.-13.VII.	Ind. to N.H., s. to N.C.	damp sphagnum fen slope fen	French Mt. Bog 425 m North Mt. 400 m French Lake	
Dolichopus lobatus	4 ♀	52 ♂, 13 ♀	27.VI.	B.C. to Ont., s. to Iowa & N.Y.	marshy lake shore, brackish water	South Harbor	
Dolichopus melanocerus	2 ♂	15 ♂, 12 ♀	10.VII.-29.VIII.	Mich. to Nfld., s. to Conn.	Picea/Betula woods damp sphagnum fen	Mackenzie Mt. 300 m North Mt. 400 m	
Dolichopus nigricornis	6 ♂, 7 ♀	46 ♂, 43 ♀	27.VI.-29.VIII.	Alaska, B.C. to N.S., s. to Colo. & N.Y.	marshy lake shore, brackish water mixed dry mesophytic woods spruce/poplar wood damp sphagnum fen Picea/Betula woods	South Harbour Middlehead North Mt. 400 m Mackenzie Mt. 300 m	
Dolichopus nubifer	1 ♂	2 ♂, 1 ♀	27.VII.	Nev., Man., Idaho, Utah, Nebr., & Mich.	dry spruce/birch forest	North Mt. 400 m	New to N.S.
Dolichopus ornatipennis	31 ♂, 27 ♀	16 ♂, 17 ♀	28.VI.-11.VII.	Mass., N.Y. to N.S., s. to N.C.	damp sphagnum fen slope fen	North Mt. 400 m French Lake French Mt. Bog	

Dolichopus ovatus	1 ♂, 1 ♀	3 ♂, 5 ♀	23.VI.	B.C. to Que. s. to Idaho & N.C.	pool margin with Typha, Juncus, & coarse fern	Cape North	New to N.S.
Dolichopus palaestricus	4 ♂	152 ♂, 18 ♀	29.VI.-8.VII.	Ont. & N.Y., s. to Ill. & N.J.	muddy roadside ditch slight water flow dry mixed forest freshwater tidal marsh	Dingwall Pleasant Bay	
Dolichopus plumipes	8 ♂, 6 ♀	136 ♂, 90 ♀	18.VI.-29.VI.	Alaska to NWT., s. to Calif., Ark. & Mich.; Mexico	marshy shore, tidal river marshy lake shore, brackish water wet Carex marsh mixed dry mesophytic woods	Ingonish Ctr. South Harbour	
Dolichopus pugil	14 ♂, 16 ♀	43 ♂, 59 ♀	18.VI.-15.VII.	Ont. to N.S., s. to N.J.	marshy lake shore, brackish water wet Carex marsh mixed dry mesophytic woods marshy shore, tidal river freshwater tidal marsh	Pleasant Bay South Harbour Ingonish Ctr.	
Dolichopus remipes	1 ♂, 1 ♀	9 ♂, 3 ♀	2.VII.	Wash. to Man. and Maine, s. to Wiss.	sweeping Ericaceae, Carex & Scirpus	Paquette Lake	New to N.S.
Dolichopus scoparius	3 ♂, 1 ♀	48 ♂, 31 ♀	29.VI.-8.VII.	Maine, Mass.	muddy roadside ditch with slight water flow dry mixed forest	Dingwall Pleasant Bay	
Dolichopus setifer	2 ♂, 3 ♀	36 ♂, 31 ♀	6.VI.-10.VII.	Ont. & Que. s. to NC	sweeping Ericaceae, Carex, & Scirpus damp sphagnun fen wet Carex marsh on sand beach	Paquette Lake North Mt. 400 m South Harbour	New to N.S.
Dolichopus sicarius	2 ♂	1 ♂	7.VII.	Ont. Mich., Que., N.S.	Picea/Betula woods mixed dry mesophytic woods	Mackenzie Mt. 300 m South Harbour	New to Maritimes
Dolichopus sincerus	9 ♂, 5 ♀	12 ♂, 9 ♀	10.VIII.-18.VIII.	Oreg., to N.S. s. to N.C.	damp sphagnum fen	North Mt. 400 m	

Dolichopus socius	15 ♂, 8 ♀	47 ♂, 12 ♀	18.VI.-11.VII.	Oreg. to & N.S., s. to Iowa & N.J.	marshy shore, tidal river mixed dry mesophytic woods marshy lake shore, brackish water dry weedy roadside & meadow muddy roadside ditch with slight water flow	Ingonish Ctr. South Harbour Dinghall	
Dolichopus splendidulus	30 ♂, 12 ♀	57 ♂, 23 ♀	18.VI.-11.VII.	Wis. & Ill. to N.S.	marsh shore, tidal river Picea/Betula woods wet bare sand shore mixed dry mesophytic woods damp ground with Carex wet Carex marsh on sand beach	Ingonish Ctr. Mackenzie Mt. 300 m S. Harbour	
Dolichopus subdirectus	2 ♂, 2 ♀	6 ♂, 13 ♀	2-7.VII.	N.H., Mass, Maine	damp sphagnum fen sweeping Ericaceae	Mackenzie Mt. 300 m North Mt. 400 m Paquette Lake	New to N.S.
Dolichopus trisetosus	10 ♂, 2 ♀	15 ♂, 13 ♀	28.VI.-11.VII.	Ont. to N.B., s. to N.Y.	damp sphagnum fen dry mixed forest sweeping Ericaceae dry spruce/birch forest muddy roadside ditch	North Mt. 400m Pleasant Bay Paquette Lake Dingwall	
Dolichopus variabilis	3 ♂	16 ♂, 7 ♀	2-11.VII.	B.C. to N.S., s. to Colo. & N.C.	dry mixed forest	Pleasant Bay South Harbour	
Gymnopterus annulatus	4 ♂, 1 ♀	2 ♂, 1 ♀	10.VII.83	N.S., Mich. Conn., Va., N.C.	dry marsh, very mixed vegetation	Bay St. Lawrence	
Gymnopterus currani	1 ♂	3 ♂, 8 ♀	6.VII.83	Conn., N.Y., N.H., Que. (Nr. Ottawa)	swept under overhanging trees	Clyburn Brook	
Gymnopterus difficilis	2 ♂	10 ♂, 16 ♀	4.VII.-29.VIII.83	Ont. to N.S., s. to Fla.	damp sphagnum fen	North Mountain	
Gymnopterus frequens	34 ♂, 12 ♀	117 ♂, 109 ♀	20.VI.-11.VII.83	Ont. & Que., s. to Iowa & Ga.	along fast rocky stream sand beach spruce/poplar wood Betula wood dry vaccinum & sphagnum	Lone Shieling Beulach Ban S. Harbour Middle Head Mackenzie Mt. C.B. Nt. Pk. 260 m	

Gymnopterus humilis	8 ♂, 3 ♀	102 ♂, 66 ♀	27.VI-2.VII.83	Kans. & Mich. to Que., s. to N.C.	mixed dry mesophytic woods marshy lake shore, brackish water damp ground with Carex & Iris	S. Harbour	
Gymnopterus nigribarbus	7 ♂, 2 ♀	58 ♂, 6 ♀	8.VII.83	Mich. to N.S., s. to N.J.	muddy roadside ditch with slight water flow	Dingwall	
Gymnopterus scotias	1 ♂	11 ♂, 4 ♀	1.VII.	Man. to N.S., s. to Iowa & N.J.	damp Picea/Abies forest	North Mountain 400 m	
Gymnopterus subdilatatus	1 ♂	53 ♂, 54 ♀	10.VII.83	Maine to Tenn. and Ga.	muddy roadside ditch with slight water flow	Meat Cove	
Gymnopterus n.sp.	2 ♂		28.VI.84		damp sphagnum fen	North Mountain	
Hydrophorus chrysologus	1 ♂, 3 ♀	148 ♂ & ♀	8.VI.-22.VI.83	Alaska; Man. to N.S.; s. to Colo. & N.Y.	damp sphagnum fen	North Mt. 400 m	common in this area
Hydrophorus philombrius	1 ♂	31 ♂, 70 ♀	22.VI.	Wash. to Que., s. to Calif. & Texas	wet Carex marsh on sand beach	South Harbour	
Hydrophorus n.sp.	1 ♀		6.VI.83	Labrador	damp sphagnum fen	North Mountain 400 m	previously known only from Labrador
Medetera veles	4 ♂, 5 ♀	90 ♂, 185 ♀	29.VI.-11.VII.83	Idaho, to Man. & N.H., s. to Utah & Fla.	dry sand beach	S. Harbour	
Medetera sp.	3 ♂, 4 ♀		24.VI.-6.VII.83		swept under under-hanging trees spruce/poplar wood mixed dry mesophytic wood	Clyburn Brook Middle Head S. Harbour	
Micromorphus sp.	1 ♀		5.VII.83		mixed dry mesophytic wood	S. Harbour	
Millardia intentus	13 ♂, 24 ♀	11 ♂, 10 ♀	18.VI.-11.VII.83	Mass.	wet sand beach marshy shore tidal river	S. Harbour Ingonish Ctr.	

Neurigona arcuata	1 ♂, 2 ♀	7 ♂, 5 ♀	1.VII.83	Ont., Mich. N.Y., Tenn.	over small stream in maple forest	Lone Shieling
Neurigona disjuncta	4 ♂	5 ♂, 5 ♀	4.VII.-12.VII.	E. Canada s. to Ga.	Picea/Betula woods mixed dry mesophytic woods	Mackenzie Mt. 300 m South Harbour
Neurigona maculata	2 ♂	2 ♂, 1 ♀	12.VII.	Wis. to Que., s. to N.C.	mixed dry mesophytic woods	South Harbour
Parasyntormon rotundicorne	6 ♂	17 ♂ + ♀	10.VII.83	N.S.	dry marsh, very mixed vegetation	Bay St. Lawrence
Pelastoneurus abbreviatus	3 ♂, 5 ♀	23 ♂, 30 ♀	5.VII.-11.VII.83	Ont. to N.S., s. to Ill. and N.C.	wet sand beach	S. Harbour dry marsh mixed vegetation Bay St. Lawrence
Peloropeodes brevis	1 ♂, 5 ♀	7 ♂, 6 ♀	8.VII.83	N.Y., Ont. to Conn., s to Ga.	sweeping bare gravel river shore swept along flat rocky stream	S. Br. N. Aspy R. Beulach Ban Falls
Rhaphium armatum	1 ♂, 6 ♀	2 ♂	20.VI.83	Que., N.Y., N.C.	mixed wood with small stream	C.B.H. Nat. Pk.
Rhaphium brevilamellatus	2 ♂, 3 ♀		18.VI.83	Va.	marshy shore, tidal river	Ingonish Ctr.
Rhaphium furcifer	3 ♂	1 ♂	21.VI.83	Que.	alder thicket with small stream damp hillside, mixed forest	North Mountain 400 m Fishing Cove Trail
Rhaphium punctitarsis	16 ♂, 5 ♀	13 ♂, 7 ♀	26.V.	Que., Man., Mich.	flood plain	Cheticamp
Rhaphium signiferum	1 ♂	18 ♂, 10 ♀	9.VII.83	Ont. to N.S., s. to N.C. & Tenn.	mixed dry mesophytic woods	S. Harbour
Rhaphium sp.	2 ♀		18.VI.83		marshy shore, tidal river	Ingonish Ctr.

Scellus exustus	1 ♀		10.VII.83	Wash. and Alta. to Maine, s. to Colo. and N.Y.	dry marsh, mixed vegetation	Bay St. Lawrence
Syntormon n. sp.	1 ♂		18.VIII.83			North Mountain 400
Tachytrechus binodatus	1 ♂	10 ♂, 13 ♀	8.VII.83	Alaska, Ont. & Que. s. to Tenn.	muddy roadside ditch with slight waterflow	Dingwall
Tachytrechus moechus	2 ♂	2 ♂, 3 ♀	4.VII.-7.VII.83	Ont. & Que., s. to Iowa & S.C.	damp sphagnum fen	North Mountain 400 m
Thinophilus ochrifacies	3 ♂, 5 ♀	59 ♂, 66 ♀	19.VI.-11.VII.83	N.Y. & N.S. s. to Mo. & Fla.	wet sand beach, algae sparse muddy shore of brackish lake wet bare sand shore	S. Harbour
Thinophilus sp.	2 ♂		27.VI.-8.VII.83		muddy shore of brackish lake muddy roadside ditch	S. Harbour Dingwall
Thrypticus sp. a	2 ♂		6.VII.83		dry bog with sphagnum	Cape Smokey
Thrypticus sp. b	1 ♂		10.VII.83		muddy roadside ditch with slight water flow	Meat Cove
Thrypticus sp. c	2 ♂		29.VI.83		mixed dry mesophytic woods	S. Harbour
Thrypticus sp. d	9 ♂		23.VI.-5.VII.83		mixed dry mesophytic woods dry marsh grass	S. Harbour Cp. North
Thrypticus sp. e	3 ♀		29.VI.-5.VIII.83		mixed dry mesophytic woods	S. Harbour
Thrypticus fraterculus	15 ♂, 9 ♀	2 ♂, 1 ♀	19.VI.-29.VI.83	Alaska, Minn. to Ont., s. to Calif. & Tenn.; Mexico	marshy lakeshore with brackish water dry marsh grass	S. Harbour Cp. North

Infraorder Muscomorpha

Probably the bulk of the species of Diptera found in Cape Breton Highlands National Park belong to this infraorder. This group possess a number of evolutionary novelties not found elsewhere in the order. The larva, which is universally recognized and referred to as a maggot, is highly modified, with almost no head, and only a pair of hook-like mandibles for mouthparts (rudiments of other mouthparts are present but difficult to detect). When fully developed and ready to pupate, the thin, usually transparent cuticle of the larva undergoes a pronounced chemical change, becoming brown and tough, and the entire larva shrinks into a barrel-shaped puparium, inside which the pupa is eventually formed. As mentioned above, soldier fly pupae are also formed inside the last larval skin, but such a pronounced chemical change in the larval cuticle does not occur in soldier flies. The pupa of the muscomorphan inside its puparium is soft and delicate, but may still be better protected from bacterial and fungal attack than the exposed pupae of other insects. When ready to emerge, the adult must force open the anterior end of the puparium, and the manner in which this is done forms the basis for the two subdivisions, Aschiza, and Schizophora, of the infraorder. Members of the division Aschiza have no special device for escaping from the puparium, while those of the Schizophora inflate the head anteriorly, and at the time of emergence, certain areas of the head capsule are extensible. The anterior part just above the antennae is especially extensible, forming an inflated sac-like protrusion called the ptilinum. Soon after emergence, the ptilinum is withdrawn inside the head, leaving an inverted U-shaped groove on the front of the head, the ptilinal fissure. The ptilinum can also be used to help the fly force its way through rather solid earth, and a few species even have it equipped with backwardly-pointed spines.

Division Aschiza

Family Syrphidae (flower flies) (by J. R. Vockeroth).

The Syrphidae, commonly known as flower flies or hover flies, are small to large, slender to robust, from 4 to 25 mm in length. Most are black and moderately shining with yellow, orange or red markings; a few are entirely black, yellowish or greyish. Many of the species have a strong resemblance to wasps or bees, especially bumble-bees; species of the later group are often covered with long red, yellow, white or black hairs. Because of this undoubted mimicry of stinging insects Syrphidae are among the most conspicuous of all flies.

About 800 species of Syrphidae occur in America north of Mexico; of these, ca 113 are known from CBHNP or the immediate vicinity. Of one of the two larger subfamilies, the Syrphinae, 166 species are known in Canada and 55 species in CBHNP.

Three subfamilies are recognized. Larvae of the species of Syrphinae are all or almost all predacious; most Canadian species feed only on aphids, but one feeds on scale insects and one on larvae of leaf beetles. The larvae are maggot-like and many can be found exposed among their prey.

Larvae of the larger subfamily Eristalinae are very diverse in form and habits. They live in decaying vegetation, in tissues of plants, in fungi, in decaying wood, in dung, in wounds of trees, in nests of bumble bees, in wet peaty or marshy soil, in clean or polluted still water, or feed on aphids (this latter group should perhaps be considered Syrphinae).

The third subfamily, Microdontinae, with 11 Canadian species, has larvae which have several times been described as molluscs. They live in nests of ants where they feed on waste material; they are oval in dorsal view, with a flattened lower surface and convex upper surface.

Adults of the first two subfamilies, but apparently not of the Microdontinae, are conspicuous flower visitors. They probably all feed on nectar and pollen; many species, especially those with long dense body hairs, are undoubtedly important as pollinators. It has been suggested that next to bees they are the most important pollinators of fruit crops, but little definite evidence is available. Much more attention has been paid to the role of larvae as predators of aphids; they do eat large numbers, but apparently only occasionally have much effect on aphid populations. Three Canadian species of Eristalinae, all introduced accidentally from Europe, infest bulbs of onions, tulips, narcissi, etc., but are usually, if not always, secondary invaders in damaged bulbs. They are known as bulb flies. Only one specimen was taken in CBHNP so they are apparently of no significance there.

Almost all available Canadian specimens of Syrphinae, both in the CNC and other collections, have been identified. Study of the Eristalinae has been far less thorough. Females of some species of the syrphine genera *Sphaerophoria, Platycheirus, Eupeodes* and *Parasyrphus*, and males of two species of *Syrphus*, cannot be identified; this accounts for the apparent absence of one sex of some species of these genera.

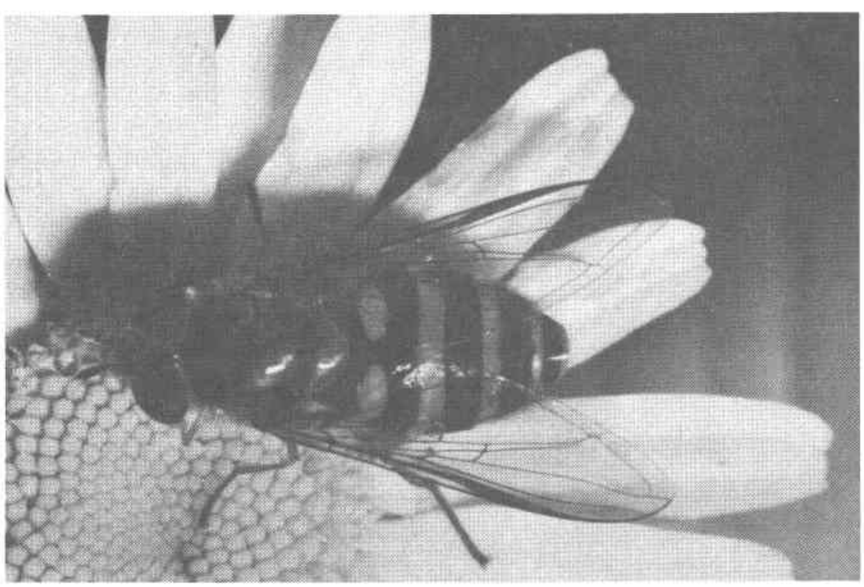


Fig. 8. *Syrphus ribesii* (Linnaeus) ♀. This widespread Holarctic species is one of the commonest syrphids on flowers.

There is apparently a marked difference in abundance of a few species during the two years of the survey. This may be due in part to chance - different people collected Diptera at slightly different times of year during the two seasons, and in part concentrated on different habitats, but this does not seem to me to account fully for the differences. Diptera were collected actively by one or more people, from May 30 to June 1, and from June 18 to July 14, in 1983, and from May 25 to June 13, and from June 24 to July 15 in 1984. All five collectors collected in a variety of habitats in many localities in the park; in addition, many specimens were taken in Malaise and/or pan traps which were operated during most of both seasons in a number of very different habitats. The figures below indicate, for several species, the number of specimens taken in each year, the range of collection dates, and the number of localities in the park where the species was taken.

	1983	1984
Metasyrphus lapponicus (Zett.)	19 ♂, 7 ♀ 10 localities 21.VI-11.VII	none
Meliscaeva cinctella (Zett.)	3 ♂, 12 ♀ 8 localities 10.VI-15.VII	5 ♀ 5 localities 24.VI-13.VII
Platycheirus confusus (Cn.)	8 ♀ 6 localities 18.VI-6.VII	50 ♂, 32 ♀ 10 localities 25.V-28.VI
Sphaerophoria longipilosa Knutson	1 ♂ 1 locality 6.VI	6 ♂ 3 localities 1.VI-11.VI
Melangyna lasiophthalma (Zett.)	1 ♀ 1 locality 1.VII	10 ♂, 33 ♀ 8 localities 26.V-30.VI
Platycheirus n. sp.	8 ♂, 15 ♀ 7 localities 20.VI-13.VII	1 ♂, 2 ♀ 3 localities 2.VI-13.VII
Leucozona lucorum (L.)	4 ♂, 22 ♀ 5 localities 25.VI-13.VII	none

Family Pipunculidae (big-headed flies).

Adults of this small family are also flower and honeydew visitors. Larvae develop as internal parasites of leafhoppers (Cicadellidae) and related Homoptera. Although several species were apparently collected in the Park, the taxonomy of the group is poorly developed and the species are quite similar, so it is not possible to estimate the Park's fauna.

Family Phoridae.

Adults of this large family of minute species are called scuttle flies because of their rapid jerky motion; some have been called coffin flies because of their habit of breeding in carcasses. Larvae also develop in dead snails, dead insects and other invertebrates, as well as other minor forms of carrion. A few minute species, some with bizarre, wingless or short-winged adults, are associated with ants' nests; unfortunately none of these unusual species was collected in Cape Breton. As in the preceding family, the taxonomy of this family is in such an undeveloped state that it is not possible to say more about the Park's species other than that the majority of specimens collected belong to the genus *Megaselia* Rondani.

Family Lonchopteridae.

Only a few specimens of this small family, probably *Lonchoptera furcata* (Fallen), were collected. This species is evidently parthenogenetic in North America, for males are unknown. Larvae presumably feed on fungi.

Family Platypezidae (flat-footed flies).

Adults of this family derive their name from the hind tarsi of some species, which are peculiarly enlarged, with flattened undersurfaces. Although it has been determined for only a minority of species, mostly belonging to the genus *Platypeza*, larvae develop in mushrooms and are consequently most abundant in the autumn. Perhaps this explains why only a few specimens were collected. An unusual habit of the males of one genus, *Microsania*, is their attraction to smoke, and they are normally collected only in the vicinity of campfires or at light. Unfortunately no specimens of this interesting genus were collected in the Park.

Summary of Syrphinae of CBHNP

	Specimens collected	Dates collected	Specimens in CNC	Habitat	Distribution	Comments
Baccha elongata (Fab.)	1 ♀	18.VI	34 ♂, 78 ♀	Upland barren	Widespread; cool temperate	New to Maritime Provinces
Chrysotoxum derivatum Walk.	1 ♂, 4 ♀	11-15.VII	70 ♂, 163 ♀	Upland bog	Widespread; boreal, cool temperate	
C. flavifrons Macq.	6 ♀	18.VI-11.VII	253 ♂, 347 ♀	Upland bog; lowland forest	Widespread; boreal, cool temperate	
Dasysyrphus pauxillus (Will)	1 ♀	12.VI	80 ♂, 161 ♀	Lowland mixed forest	Widespread; boreal, cool temperate	New to Nova Scotia
D. venustus (Mg.)	12 ♂, 8 ♀	7.VI-4.VII	212 ♂, 639 ♀	Upland bog; birch-spruce forest; lowland mixed forest; dry beach ridge	Widespread; boreal, cool temperate	
Didea alneti (Fall)	1 ♂, 1 ♀	27.VI.-1.VII	13 ♂, 16 ♀	Upland bog; upland barren	Widespread; boreal	
Doros aequalis (Lw.)	3 ♂, 1 ♀	8.VI-1.VII	32 ♂, 23 ♀	Lowland mixed forest; coastal headland	Widespread; cool temperate	New to CBI
Epistrophe emarginata (Say)	1 ♀	28.V	60 ♂, 92 ♀	Moist meadow	Widespread; boreal, cool temperate	New to Nova Scotia
E. nitidicollis (Mg.)	4 ♀	6-30.VI	27 ♂, 29 ♀	Upland bog; lowland mixed forest	Widespread; cool temperate	New to CBI
E. xanthostoma (Will.)	1 ♂, 6 ♀	25.VI-12.VII	36 ♂, 22 ♀	Upland bog; upland barren; lowland mixed forest	Widespread; cool temperate	New to CBI
Eriozona laxa (O.S.)	1 ♂, 3 ♀	9.VI-15.VII	121 ♂, 174 ♀	Birch-spruce forest; lowland mixed forest	Widespread; boreal, cool temperate	
Eupeodes americanus (Wied.)	1 ♂	10.VIII	130 ♂	Upland spruce forest	Widespread; cool temperate	
Eupeodes lapponicus (Zett.)	19 ♂, 7 ♀	21.VI-15.VII	833 ♂, 649 ♀	Upland barren; upland bog; lowland mixed forest; upland spruce forest	Widespread; boreal, cool temperate	New to CBI
E. latifasciatus (Macq.)	6 ♀	1.VI-6.VII	112 ♂, 82 ♀	Upland bog; spruce-birch forest; lowland mixed forest	Widespread; boreal, cool temperate	New to CBI

E. luniger (Mg.)	4 ♂, 4 ♀	7.VI-8.VII	90 ♂, 249 ♀	Upland bog; spruce-birch forest; lowland mixed forest	Widespread; boreal, cool temperate	New to Maritime Provinces
E. perplexus (Osb.)	1 ♂	15.VII	38 ♂, 92 ♀	Upland barren	Widespread; cool temperate	New to Nova Scotia
E. volucris O.S.	1 ♀	6.VII	186 ♂, 354 ♀	Upland bog	Widespread; cool to warm temperate; mostly western	New to Nova Scotia
Leucozona lucorum (L.)	4 ♂, 21 ♀	25.VI-15.VII	28 ♂, 29 ♀	Upland bog; spruce-birch forest	Widespread; low boreal, cool temperate	New to CBI
Melangyna lasiophthalma (Zett.)	10 ♂, 34 ♀	26.V-1.VII	76 ♂, 230 ♀	Upland bog; spruce-birch forest; lowland forest; moist meadow	Widespread; boreal, cool temperate	New to CBI
M. triangulifera (Zett.)	1 ♀	31.V	48 ♂, 87 ♀	Flood plain forest	Widespread; low boreal, cool temperate	New to CBI
M. umbellatarum (Fab.)	2 ♂, 1 ♀	24.VI-8.VII	113 ♂, 212 ♀	Lowland spruce-poplar forest	Widespread; low boreal, cool temperate	
Melanostoma mellinum (L.)	57 ♂, 64 ♀	31.V-15.VII	837 ♂, 4248 ♀	Upland bog; upland barren; spruce-birch wood; mixed lowland forest; river flood plain; upland spruce forest	Very widespread; low arctic to warm temperate	
Meliscaeva cinctella (Zett.)	3 ♂, 15 ♀	10.VI-15.VII	249 ♂, 478 ♀	Spruce forest; upland bog; mixed lowland forest; river flood plain; dry meadow	Widespread; boreal, cool temperate	New to CBI
Paragus angustifrons Lw.	1 ♂	9.VI	86 ♂	Lowland mixed forest	Widespread; warm temperate	New to Nova Scotia
Paragus haemorrhous Mg.	1 ♂, 2 ♀	26-31.V	300 ♂, ca. 300 ♀	Maple forest; forest flood plain	Widespread; low boreal to tropical	New to CBI
Parasyrphus genualis (Will.)	1 ♀	6.VII	29 ♂, 51 ♀	Upland bog	Widespread; boreal, cool temperate	New to CBI
Parasyrphus n. sp.	22 ♂, 40 ♀	26.V-11.VII	71 ♂, ? ♀	Upland bog; upland spruce-birch forest; lowland mixed forest; maple forest; moist meadow	Widespread; cool temperate	New to CBI
Platycheirus angustatus Zett.	2 ♂	11.VI-7.VII	131 ♂	Upland spruce-birch forest; lowland mixed forest	Widespread; boreal, cool temperate	New to CBI

P. clypeatus (Mg.)	12 ♂	30.V-8.VII	110 ♂	Upland bog; wet Carex marsh; pool margin with Juncus, Typha	Widespread; boreal	New to CBI
P. confusus (Cn.)	52 ♂, 41 ♀	26.V-28.VI	166 ♂, 230 ♀	Mostly upland bog; upland spruce forest; lowland mixed forest; Carex marsh	Widespread; cool temperate	
P. sp. (n. name)	2 ♂, 6 ♀	22.VII-6.VII	115 ♂, ? ♀	Upland bog; upland barren	Widespread; boreal	New to Maritime Provinces
P. hyperboreus Staeg.	5 ♂, 19 ♀	18.VI-10.VIII	255 ♂, ? ♀	Upland bog; dry lowland mixed forest; marsh with Carex; dried grassy marsh	Widespread; high boreal to warm temperate	New to CBI
Platycheirus immarginatus Zett.	14 ♂, 14 ♀	23.VI-3.VII	274 ♂, ? ♀	Upland bog; pool margin with Juncus, Typha; lake margin with Carex, Iris; dried marsh	Widespread; cool temperate	New to Nova Scotia
P. inversus Ide	1 ♂	5.VII	16 ♂	Lowland mixed forest	Eastern; cool temperate	New to CBI
P. jaerensis Niel.	1 ♂	12.VI	2 ♂	Lowland mixed forest	Eastern (Holarctic, probably widespread), cool temperate	New to Maritime Provinces
P. modestus Ide	4 ♂, 1 ♀	23.VI	181 ♂, ? ♀	Dry marsh with grass, Carex, Juncus	Widespread; boreal, cool temperate	New to CBI
P. n. sp. (*petatus* auct.)	13 ♂, 17 ♀	2.VI-13.VII	58 ♂ ? ♀	Upland bog; upland spruce-birch forest; upland barren; lowland mixed forest	Widespread; temperate	New to Nova Scotia
P. obscurus (Say)	4 ♂, 4 ♀	5.VI-11.VII	358 ♂, 346 ♀	Upland bog; upland spruce-fir forest	Widespread; temperate	
P. podagratus Zett.	1 ♂	11.VII	60 ♂	Upland bog; lowland mixed forest	Widespread; boreal	New to Maritime Provinces
P. rosarum (Fab.)	4 ♂, 3 ♀	24.VI-15.VII	145 ♂, 193 ♀	Upland bog	Widespread; low boreal, cool temperate	
P. scambus Staeg.	48 ♂, 34 ♀	9.VI-11.VII	275 ♂, ? ♀	Upland bog; dry mixed lowland forest; wet and dry marsh; marshy lake shore	Widespread; boreal, cool temperate	
P. scutatus Mg.	1 ♂	31.V	26 ♂	Upland bog	Widespread; boreal	New to Maritime Provinces

P. thylax Hull	6 ♂	28.V-5.VI	27 ♂	Upland bog	Widespread; cool temperate	New to CBI
P. varipes Cn.	3 ♂	3-10.VI	39 ♂	Upland bog	Widespread; boreal	New to Maritime Provinces
Sphaeropheria abbreviata Zett.	11 ♂	31.V.-14.VII	ca. 200 ♂	Upland barren; upland spruce-fir forest; lowland mixed forest; maple forest	Widespread; boreal, cool temperate	
S. asymmetrica Knutson	20 ♂	26.V-13.VII	ca. 200 ♂	Upland spruce-fir forest; lowland mixed forest; maple forest; marsh	Widespread; cool temperate	
S. longipilosa Knutson	7 ♂	1.VI-11.VI	20 ♂	Upland bog; upland spruce-fir forest; lowland mixed forest	Eastern; cool temperate	
S. novaeangliae John.	2 ♂, 3 ♀	25.VI-29.VIII	ca. 50 ♂, 50 ♀	Upland spruce-fir forest; lowland mixed forest	Widespread; cool temperate	New to Nova Scotia
S. philanthus Mg.	14 ♂	31.V-11.VIII	ca. 400 ♂	Upland bog; upland spruce-fir forest; lowland mixed forest; maple forest; pond margin	Widespread; boreal, temperate	
Syrphus rectus O.S.	? ♂, 3 ♀	24.VI-9.VII	215 ♀	Lowland mixed forest	Eastern; temperate	
S. ribesii (L.)	4 ♂, 12 ♀	31.V-13.VII	591 ♂, 1498 ♀	Upland bog; upland spruce-birch forest; lowland mixed forest	Widespread; high boreal to warm temperate	
S. torvus O.S.	8 ♂, 8 ♀	31.V-18.VIII	817 ♂, 848 ♀	Upland bog; upland barren; lowland mixed forest	Widespread; high boreal to cool temperate	
S. vitripennis Mg.	? ♂, 11 ♀	26.V-13.VII	90 ♂, 379 ♀	Upland bog; pool margin	Widespread; high boreal to cool temperate	New to CBI
Toxomerus geminatus (Say)	1 ♂	.30.VI	435 ♂, 200 ♀	Upland bog	Eastern; warm temperate	New to Nova Scotia
T. marginatus (Say)	1	?	638 ♂, 733 ♀	Upland barren	Widespread; cool temperate to tropical	

Total: 55 species
New to Maritime Provinces 7
New to Nova Scotia 9 (plus 7 above)
New to Cape Breton I. 20 (plus 16 above)

Division Schizophora - Subdivision Acalyptratae

A large complex group of mostly small to minute flies, the acalyptrates include such species as fruit flies, leaf-mining flies and many others. Although their classification has been a matter of contention, recent studies (McAlpine *et al.* 1981) have divided them into 43 families belonging to nine superfamilies. Many of these are represented in Cape Breton Highlands National Park, but the majority are apparently of no economic importance and are not likely to be noticed by visitors to the Park. A few exceptions are noted below in the following account of the families collected.

Family Conopidae (thick-headed flies).

Adult conopids are usually uncommon. Although most are small and inconspicuous, a few are quite striking because they mimic wasps. The largest, most conspicuous, and most wasp-like species in Cape Breton is *Physocephala furcillata* (Williston), of which one specimen was collected near Pleasant Bay. Not only is it extremely wasp-like, with long, dark antennae held directly forward, narrow waist-like base to the abdomen and darkened leading edge to the wing, but it also rests conspicuously on flower heads, apparently aware of its protective appearance. Larvae of conopids are of particular interest in that they are internal parasites of adult bees and wasps. Some conopids lay their eggs on their intended victims while in flight. As was mentioned above under Asilidae, mimicry of their hosts may help them approach unsuspecting hosts with less risk of being stung.

Family Micropezidae.

A small family of slender flies with elongate legs, micropezids are most diverse in the Neotropical Region and only a few species occur in Canada. Only one species, *Rainieria antennaepes* (Say), was collected in the Park. Adults of some species resemble ants, and, as they stride about on leaves, on their long legs, they may derive some protection from this mimicry. Larvae are said to inhabit decaying vegetation.

Family Psilidae.

The carrot rust fly, *Psila rosae* (Fabricius), is the best known member of this small family. Only a few species were collected in the Park; several species of *Psila*, including *P. collaris* Loew but not *rosae*), and one species of *Chyliza* were found. Larvae feed in the stems and roots of living plants belonging to a wide range of genera.

Family Otitidae.

Adults of this moderately large family usually have patterned wings, and closely resemble members of the Tephritidae, to which they are probably also closely related (they are distinguished primarily by details of the wing venation). Larvae of most otitids are saprophagous; some live under bark of trees, or in decaying vegetation. However, a few species, not among those occurring in the Park, invade living plant tissues and are considered pests. Three species were collected in the Park; the commonest. *Chaetopsis massyla* (Walker), is a dark metallic greenish species with three dark transverse bands on each wing; its larvae bore in rushes, *Juncus* sp. Larvae of *Pseudotephritis vau* (Say) live under bark, while those of *Seioptera vibrans* (Linnaeus) are presumed to live in decaying fungi.

Family Lonchaeidae (lance flies).

Although a small family on a world basis, this family is quite well represented in the Park, where about 25 species were collected. Females of most species have long slender ovipositors, giving rise to their common name, with which they can presumably probe unopened cones or other crevices. Larvae of most species live under bark of dead and dying trees, often associated with galleries of bark beetles. Most species are innocuous but larvae of *Earomyia* infest cones of coniferous trees. Males of lonchaeids are among the few acalyptrates that aggregate in mating swarms on hilltops.

Of the approximately 25 species collected, 20 were in the genus *Lonchaea*, two were in *Dasiops* and three were in *Earomyia*. Several were new to the Maritime Provinces, and some were known previously from few specimens.

Family Tephritidae (fruit flies).

Although drosophilids (Drosophilidae, see below) are often called "fruit flies", true fruit flies, which belong to this family, develop in living fruit rather than rotting fruit. Members of the Tephritidae include the notorious Mediterranean fruit fly (the cause of a colossal scandal and expensive extermination program in California) and the apple maggot, *Rhagoletis pomonella* Walsh, which as a native species before the advent of Europeans presumably bred in hawthorns and wild crabapples. Most Canadian species, including those collected in the Park, infest the seed heads of various species of plants belonging to the family Compositae, and may be considered pests or beneficial species depending on whether the plant attacked is a crop or a weed. In spite of the pest habits of the larvae of a few species, most species are of no economic importance. In spite of their small size, adults of most tephridits are among the most colourful flies in the Park, with attractively patterned wings and metallic eyes. At least six species were collected in the Park (the species in some genera are difficult to distinguish, so the number cannot be reported for certain). The most commonly collected species was *Urophora jaceana* (Hering), a fly so superficially similar in size and coloration to the otitid, *Chaetopsis massyla* mentioned above, that the two are easily confused. *U. jaceana* is a European species, presumably introduced into North America along with its host, black knapweed, *Centaurea nigra* Linnaeus, but its presence here was not reported until 1961 (Shewell 1961). Another distinctive species, *Myoleja nigricornis* (Doane), is characteristically found in bogs and fens, although in the Park it was collected in a variety of habitats. Adult males have two pairs of relatively enormous, black, spike-like bristles on the front of the head, and wings of both sexes are intricately patterned with brown.

Family Piophilidae.

One of the best known members of this family is the cosmopolitan cheese skipper, *Piophila casei* (Linnaeus), a serious pest in the food industry. The larvae are called skippers because of their habit of curling up in a C-shaped form, gripping the hind end with their mandibles, then straightening themselves suddenly like a spring, propelling the larva several inches through the air. Adults are small and nondescript. Larvae of many species are associated with old carcasses, which consist of little but hide and bone. The larvae presumably find enough to eat in bone marrow.

Only three species were collected in the Park, but one of them was of exceptional interest, an undescribed species in the genus *Protopiophila*, that apparently is unknown from any other collection, either from North America or from Europe (so it is probably not an introduction). The other two species, *Liopiophila varipes* (Meigen) and *Stearibea nigriceps* (Meigen) were well known.

Family Clusiidae.

Another family in which many of the members have patterned wings, adults are much less common than otitids and trypetids and tend to be restricted to forested areas. Larvae live in rotten wood, and have a pair of recurved hooks at the posterior end. Only a few specimens were collected in the Park.

Family Acartophthalmidae.

A single species, *Acartophthalmus nigrinus* (Zetterstedt), is found in Eastern Canada; some specimens were collected in the Park. Adults frequent rotting fungi in damp woods, but the larvae are unknown.

Family Agromyzidae (leaf-mining flies).

Although mostly very small flies, the family is one of the largest among the acalyptrates in numbers of species found in the Park. Larvae of all agromyzids live in plant tissues, tunneling, or mining, in leaves between upper and lower surfaces. They share this habit with larvae of a variety of small moths, beetles and sawflies. Agromyzids are mostly host specific, each species producing a characteristically shaped mine, which by late summer can be found on nearly every species of vascular plant in the Park. Some species form their puparium within their mines, passing the winter in the dead leaf on the ground, others leave the mine when they have finished feeding and enter the soil to form their puparium.

Family Odiniidae.

Another small family of small flies, odiniids are rather rare. Larvae have been found in the galleries of wood-boring beetles, moths and flies. There is some dispute in the literature as to whether the larvae are saprophagous, feeding on fungi and other organisms growing in the galleries, or whether they are parasitic or predaceous on the primary tunnel-makers themselves. Only one species, *Odinia betulae* Sabrosky, was collected in the Park. It has been reared from birch logs infested with the buprestid *Agrilus anxius* Gory.

Families Opomyzidae and Anthomyzidae.

These two small families of small flies, which are presumably closely related, may be treated as a single entity for convenience. Adults are quite small, even by acalyptrate standards, and the larvae of both groups feed in grass stems. Adults of these two families are common in grassy areas.

Family Aulacigastridae.

Larvae of this small family inhabit fermenting sap in tree wounds, where they presumably feed on yeasts and other microorganisms abundant there. Only two species, *Aulacigaster leucopeza* (Meigen) and an undescribed species of *Cyamops*, were collected in the Park.

Family Asteiidae.

Larvae of this family have been found in a variety of habitats, but have been usually associated with stems, stalks, and buds of plants that have been hollowed out by other insects, where they are presumably are scavengers, feeding on microorganisms.

Family Milichiidae.

This is a moderate-sized family, whose members have quite diverse life histories. Larvae are both saprophagous and coprophagous, and have been reared from a wide array of decaying plant material. A few species are associated with ants, were they inhabit the trash piles cast out by leaf-cutter ants. Adults of a few species have commensal relationships with predatory insects and spiders which are much larger than themselves. While riding on the backs of these predators, the flies partake of juices that exude from the prey. This behavior is reminiscent of a species of fish, the remora, which rides about attached to sharks by a sucker-like organ on the top of its head - when the shark feeds, the remoras detach themselves temporarily and share the meal.

Family Coelopidae (seaweed flies).

As the name implies, all members of this family are restricted to seacoasts, where the larvae feed on decaying seaweed. One species, *Coelopa frigida* (Fabricius), was collected on the beach at Ingonish Centre in mid June.

Family Sciomyzidae (marsh flies).

Larvae of all members of this family are predators or parasites of both freshwater and terrestrial molluscs. Snails and slugs (Gastropoda) are the major hosts, but a few species attack the small freshwater fingernail clams of the family Sphaeriidae. A few species are parasitoids, that is, they feed as parasites without unduly disturbing the internal structures until nearly fully grown, when they destroy the host and devour the remains. In this respect, their feeding behaviour is analagous to that of the larvae of Tachinidae and the parasitic Hymenoptera. Adult sciomyzids are common in the vicinity of marshes, hence the common name, where their hosts abound, and may be found resting head down on emergent vegetation. They have a rather characteristic way of holding their antennae straight ahead of them, in line with the body axis. Most species are yellow or pale brown, often with spotted or patterned wings.

Family Sepsidae.

Adult sepsids are slender and ant-like and are usually found walking about on or in the vicinity of dung. When walking, they constantly raise and lower their wings. Some species have a black spot at the apex of each wing; perhaps this flitting of wings is a form of communication between the flies. Larvae breed in dung and in decaying animal matter.

Family Lauxaniidae.

Adults of this moderately large family are not often seen beyond the deep shade of the forest where they may be found resting on leaves. A moderately large family, lauxaniids are poorly known in the larval stage. Those that have been reared were found in decaying vegetation and leaf litter, where they presumably feed on microorganisms, as do larvae of most acalyptrates.

Family Chamaemyiidae.

Larvae of members of this small family are free-living predators of aphids and scale insects. Because of these habits, some species have been introduced into Canada as potential biocontrol agents. Adults are either shiny black or densely silvery or grey pruinose. One species of *Chamaemyia*, usually associated with aphids on grasses, and one of *Leucopis*, *L. americana* Malloch, associated with adelgids on conifers, were taken.

Family Heleomyzidae.

Adults of many species are yellowish, and superficially resemble sciomyzids, but their behaviour is more like that of lauxaniids. Most of them seem to prefer the depths of moist woodland, where they skulk among the mosses, ferns and leaf litter. Larvae have been found in many types of decaying plant and animal matter, such as birds' nests, mammal burrows, bat caves, carcasses, fungi and dung.

Family Sphaeroceridae (small dung flies).

Although their common name indicates where one may find many species, sphaerocerids are associated with a wide variety of habitats. They are also found in mammal nests, cave debris, rotting seawead, fungi and carrion. A few species oviposit in the dung balls of scarab beetles, where their larvae presumably compete for utilization of the dung with the larvae of the scarab. A few species can reach pest proportions in mushroom houses. Septic tanks can, if not sealed, produce millions of them, and on occasion they have been reported entering homes in vast numbers. A few species are restricted to caves. Adult sphaerocerids may be readily recognized by the short, thickened basal segment of the tarsus of the hind leg.

Family Drosophilidae (vinegar flies).

This family is familiar to everyone because its most common member, *Drosophila melanogaster* Meigen, the household fruit fly, vinegar fly or pomace fly, is a pest in late summer, especially when ripe fruit is abundant. Food-processing plants find this species a particularly serious problem. This species has many wild relatives that live in rotting fruit and mushrooms.

Family Diastatidae.

Only a few specimens of this small family related to the Drosophilidae were collected in the Park. Adults are usually taken along margins of bogs, marshes and other forest-edge habits; the larvae are unknown.

Family Ephydridae (shore flies).

Adult ephydrids are usually associated with the muddy margins of water bodies, both fresh and saline. In the latter habitats, particularly salt marshes, they are usually astonishingly abundant, running over the wet mud. They are also abundant in similar inland habitats, particularly those which are unusally alkaline or saline, in which most other species of insects are incapable of surviving. Larval habits are quite diverse. Those associated with mud filter microorganisms from the semiliquid medium in which they are surrounded. Presumably the species collected in the Park all feed in this way. Larvae of a few species mine in living plants; in rice paddies, water cress beds and in other aquatic crops, these leaf-mining larvae can cause extensive damage. Other species are predators, feeding on midge larvae, and one unusual species feeds as a parasitoid in the egg sacs of aquatic spiders.

Family Chloropidae (frit flies or grass flies).

Adult chloropids are small, smooth, shiny, yellow to blackish flies, often colourfully patterned, common everywhere, especially in grassy areas. Larvae of most members of this large family feed within developing shoots of grasses. Among these are the destructive species, *Oscinella frit* (Linnaeus) and the wheat-stem maggot, *Meromyza americana* Fitch. The larvae of other species are predaceous on root aphids.

Division Schizophora - Subdivision Calyptratae

House flies and blow flies belong to this group, and the majority of calyptrates are not often distinguished from them by the average observer. However, there are hundreds of species that may be thus confused, many so similar they are confused even by specialists, yet their life cycles and behaviour differ vastly. All members of the largest family, Tachinidae, are internal parasites of other insects, while the remainder either live in carrion, dung or other rotting vegetable matter, or actually invade living plant tissues. A few highly specialized families have become, in the adult stage, ectoparasites of birds, bats and other mammals.

Family Scathophagidae (by J. R. Vockeroth).

The Scathophagidae are a family of small to medium-sized (3 to 15 mm) slender flies. Several common species are rather densely haired but most have weak to moderate bristles and no conspicuous fine hairs. They range in colour from bright to yellow to black (several species of unrelated genera have a very similar colour pattern, with the thorax black above and yellow below, and the abdomen black); many are shining, but others, especially the grey or brownish species, are dull in colour.

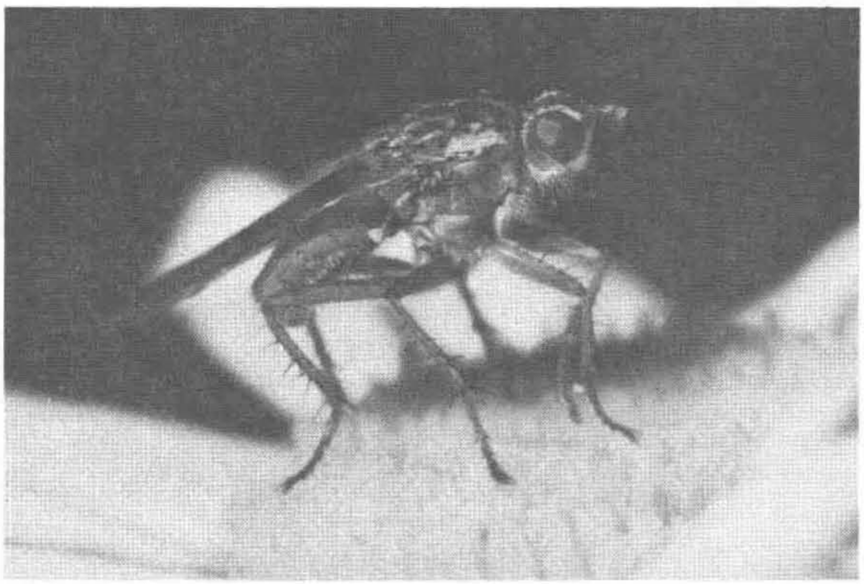


Fig. 9. *Scathophaga stercoraria* (Linnaeus) ♀. This yellow-haired species is common on cow dung and rotten grass clippings. Males use cow flaps as an assembly point and may defend territories on the pad.

Most species occur in marshy areas but some are in wet to rather dry woodland; only some of the hairy dung-feeding species are likely to be in disturbed areas. Although species of the family are commonly known as dung flies only some species of the large genus *Scathophaga* have dung-feeding larvae; other species of the genus live in seaweed or, in the arctic, in carrion. Larvae of some other species of Scathophaginae apparently live in wet soil or, in a few cases, in water, and are presumably predaceous. A considerable number are phytophagous; a single genus of flies usually has a restricted range of host plants. Of those found in the park, the larvae of *Cordilura* live in the base of leaf bundles of *Carex*, *Juncus*, and *Scirpus* (and are preyed upon by larvae of one or more species of *Orthacheta*); larvae of *Nanna* feed on developing flower heads of Gramineae (several Old World species can be serious pests of *Phleum*); the larvae of *Orthacheta dissimilis* Malloch (a new genus is required for this species) form galls in young leaves of *Iris*. All known larvae of species of the small subfamily Delininae are leafminers in monocots, particularly Orchidaceae and Liliaceae. Five species of the subfamily were taken; the larvae of *Delina nigrita* (Fallen) have been reared from leaf mines in *Smilacina* and in Europe have been reported from several species of Orchidaceae. Those of *Hexamitacus tricincta* (Lw.) have been reared from *Smilacina*; those of *Parallelomma vittatum* (Mg.) occur in both Liliaceae and Orchidaceae. With the exception of those of the species of *Cordilura* of the eastern United States larvae are very poorly known.

Adults are thought to be predacious on small insects although only a very few species of genera other than *Scathophaga* have been determined to be.

The family is certainly the most northern of all families of Diptera, and perhaps of all insects. In North America about 23 species (of an estimated total of 200 species) and eight genera or subgenera are confined to the arctic tundra or high alpine areas and many more are high boreal or montane. The greatest number of species occurs in southern Canada and the northern United States. The number declines rapidly southward; only five species are known in Mexico and three in South America (and two of these three from single specimens).

Thirty-eight species were taken in the Park. Of these, 29 were taken in the bogs on North Mountain or French Mountain; some of these were taken in other habitats as well, but many were not. Only a few of the more interesting species will be mentioned.

The genus *Nanna* was particularly interesting. About 25 species occur in North America (many of these are undescribed). Only one species was previously represented in the C.N.C. from Nova Scotia; 10 were taken in the park (nine of these were in upland bogs). Two species apparently new to the C.N.C. were taken. An apparent male of a species known from five females from Gatineau Park, Que., was collected. Two females of *N. leucostoma* (Zett.), known in North America from a few specimens from Alaska, northern Quebec and Gatineau Park, were taken. *N. katmaiensis* (Malloch), known from southern Labrador northward and westward, was represented by 11 males and two females, all from the bog on North Mt.

Delina nigrita, a markedly boreal species not known closer to N.S. than Great Whale River, Que., was moderately abundant; 15 males were taken in the bog on North Mt.

Cordilura masconina Cn., known from the north shore of the St. Lawrence R. northward and westward was taken in small numbers on the marshy shores of South Harbour Lake.

One male of *Acanthocnema albibarba* (Loew) was taken by sweeping over a very small fast stream at Lone Shieling. The species was not previously known from Canada. Records were from New England and the Adirondack Mts. south to North Carolina; the species has an entirely Appalachian distribution. All species of the genus appear to be associated with fast clean streams, and at least one is known to have aquatic larvae.

Scathophaga suilla (Fab.), a widespread but predominantly boreal species which has been reared from dung of pigs and of rodents such as muskrats and collared lemmings, was present in large numbers (uncounted, but several hundred at least) in the trap material from the bog on North Mt. It is beyond doubt the most abundant species of the family in the park.

Family Anthomyiidae (root maggots).

As their common name implies, many larvae of this family attack stems and roots of plants below ground level. Some of them, such as the onion maggot, *Delia antiqua* (Meigen), the radish maggot, *D. brassicae* (Bouché) and various other members of the genus are notorious agricultural pests. A few species mine leaves in the manner of agromyzids; one common species in the leaves of lambs' quarters is the spinach leaf miner, *Pegomyia hyoscyami* (Panzer).

The family is large and its members difficult to identify, and we have not been able to estimate accurately the number of species that were collected in the Park. However, the most interesting species taken was an undescribed species in the genus <u>Chirosia</u>. Known members of this genus mine in the stems of bracken fern, <u>Pteridium aquilinum</u>, and presumably this one may do the same.

Family Muscidae (house flies).

The house fly, *Musca domestica* Linnaeus, the face fly, *Musca autumnalis* De Geer, the stable fly, or biting house fly, *Stomoxys calcitrans* (Linnaeus), and the horn fly, *Haematobia irritans* (Linnaeus) are the best known members of this family because they are pests of man and domestic animals. The face fly, a medium-sized house-fly-like species, is an annoying, persistent insect, especially in spring, that crawls on exposed skin lapping up perspiration. It is quite alert and difficult to swat. It was accidentally introduced from Europe in the 1950's and rapidly colonized North America. The other three above-mentioned species were undoubtedly introduced from Europe during the early days of settlement. The horn fly is an obligatory pest of cattle and probably is rare in the Park. A similar, smaller, native species, the moose fly, *Haematobosca alcis* (Snow), also occurs in the Park; specimens were collected at French Lake and in North Mountain bog, but it is probably widespread in the interior boreal part of the Park. It is associated only with moose, and breeds in moose dung, just as the horn fly is associated only with cattle and breeds only in its dung. The face fly also requires cow dung in which to breed, but adults range far and wide. The stable fly also may breed in dung, but is equally fond of decaying seaweed or other rotting vegetation and so may be common along both coasts, especially in late summer. Stable flies look even more like house flies, but may be readily distinguished by the long, sharp proboscis projecting from the head (except when it is trying to bite). They bite, not by inserting stylets as do mosquitoes, or by slicing the skin as do black flies and horse flies, but by ramming the entire proboscis into the skin, with the help of some recurved spines at the apex. The resulting bite is much like the stab of a pin, yet the fly is so wary that it is nearly impossible to swat. Stable flies can be particularly irritating to those on the beach or in a boat, for repellents seem ineffective and they cannot be killed easily, except perhaps with a fly-swatter. Not only are they wary and persistent, but they seem incapable of getting sufficient blood without biting their victims innumerable times. The house fly, readily distinguished from any other fly by its refusal to escape from one's house or car, even when pursued, breeds in garbage as well as dung, and is a pest wherever man lives. In tropical areas, house flies are instrumental in spreading disease organisms, especially those causing intestinal problems, but at the latitude of Cape Breton they are probably seldom important in this respect. Other, rather persistent, pestiferous species, especially in spring and fall, that behave much as do face flies, but which is metallic blue rather than grey, belong to the genus *Pyrellia*.

In addition to these pestiferous and biting species, which combine forces to lessen enjoyment of Park visitors, there are dozens, perhaps hundreds, of other, similar-looking, but entirely innocuous species, occurring in all habitats throughout the Park.

The most unusual muscid record from the Park was the collection of two males of *Pseudocoenosia abnormis* Stein (Muscidae) which were taken in the bog on North Mountain (400 m.). The species is widespread but uncommon in western Europe; it has not previously been recorded from North America. It is unlikely to have been introduced by man.

Family Calliphoridae (blow flies and cluster flies).

Blow flies, which include the large familiar bluebottle and greenbottle flies, are among the most familiar Diptera. Adults may at times be a pest when one is trying to eat outdoors, and they can occasionally spoil meat if it is left uncovered, but collectively they play an extremely important role in the ecosystem. Female blow flies are among the first insects to find carcasses, and their maggots quickly devour it, no matter whether it is a mouse or a moose. The hundreds or thousands of resulting individuals of the next generation thus spread the nutrient material of that carcass over an enormous area. Without them, all that organic material would be concentrated in one place, too concentrated for the benefit of plants in the immediate vicinity, yet of no value to more distant ones.

Ten species were collected in the Park. The two large common bluebottles, *Calliphora vomitoria* (Linnaeus), and *Cynomya cadaverina* Robineau-Desvoidy, a smaller bluebottle, *Protophormia terraenovae* (Robineau-Desvoidy), and the greenbottles, *Lucilia illustris* (Meigen) and *L. sericata* (Meigen), were collected in numbers in many localities, and probably are ubiquitous in the Park. Their larvae live in carcasses and garbage. A much less common greenbottle, *L. silvarum* (Meigen) is an obligate parasite of toads (and probably frogs as well); the amphibian does not survive the encounter but presumably dies of infection and other secondary complications. Another common species, the cluster fly, *Pollenia rudis* (Fabricius), is also ubiquitous in the Park. Introduced from Europe, their larvae are parasitic on earthworms. The worms probably do not survive either, so both *silvarum* and *rudis* should be considered parasitoids. One specimen of the genus *Protocalliphora* was collected in North Mountain bog. Although the adult looks much like an ordinary bluebottle, the larvae are external, bloodsucking parasites of nestling birds. The larvae live in the nest, and draw blood from the legs and other exposed parts of the nestlings. When in reasonable numbers, these larvae are presumed not to be too harmful, but when abundant, they may contribute to deaths of nestlings by taking too much blood. There are several species in the genus in Eastern Canada, with some partitioning of the available avifauna; *P. sialia* Shannon and Dobroscky is common in hole-nesting species such as tree swallows; *P. metallica* (Townsend) infests only ground nesting birds, such as sparrows and juncos, while *P. avium* Shannon and Dobroscky may be found in hundreds in large nests such as those of crows, ravens and hawks.

One of the most unusual species taken, the first record for the Maritimes (although the species has turned up in Labrador) is *Acronesia montana* (Shannon). A series of males was collected at the south end of the French Lake bog. It appears to be a rather northern species, perhaps restricted to bogs, and is probably not often collected because its habitat is inaccessible.

Family Oestridae (bot and warble flies).

Although relatively rare, members of this family attract considerable attention because their larvae are obligatory parasites of mammals. Adults of most Eastern Canadian species resemble bumble bees. Because their populations are probably always small, mimicry may be vital to stave off predators to ensure continued survival of the species. Adults' mouthparts are degenerate, and they do not feed, although they can imbibe water. The best known members of the family are parasites of domestic animals, the warble flies of cattle, the nose bot of sheep and the stomach bots of horses. Although none of these was collected in the Park, they presumably occur in the livestock living around the perimeter. Two species were collected in the Park, the nose bot of white-tailed deer, *Cephenemyia phobifer* (Clark), and the warble fly of mice, *Cuterebra grisea* Coquillett.

In early summer, adult females of the nose bot approach deer and hover beneath the chin, periodically making rapid dashes toward the nose on which they squirt droplets of fluid containing active newly-hatched larvae. It was once assumed that these larvae crawled into the nostrils and made their way to the pharynx via the nasal passages, but recent observations have shown, at least for a closely related western species, that larvae crawl down, enter the mouth then crawl along the palate to the pharynx. A band of hair prevents them from entering the nostrils. Once in the pharynx, they grow slowly during the summer, fall and winter, reaching a startlingly large size, nearly as large as the last two joints of one's little finger. In Algonquin Park, Ontario, over 100 full grown larvae have been found in a single deer, associated with considerable enlargement of the pharynx. In spring larvae make their way down the nasal passages to the nostrils, and are ejected to the accompaniment of violent snorting and sneezing. Pupation takes place on the ground and adults emerge a few weeks later. The single specimen of this species taken in the Park was a male collected at French Lake bog in an interception trap. Although the normal host, at least in Ontario, of *phobifer*, is the white-tailed deer, it is conceivable that moose may also be infested on occasion, although records of larvae of *Cephenemyia* in moose in North America are rare (in Northern Europe, another species which does not occur here regularly infests moose).

Cuterebra grisea infests deer mice, *Peromyscus maniculatus*, and microtine rodents, which in the Park presumably include *Clethrionomys gapperi* and *Microtus pennsylvanicus*. Adult females flies emerge in mid summer, then after mating, fly about the forest presumably looking for mouse runs and other suitable sites in which to oviposit. Eggs are never laid on the mice, but on objects with which they might come into contact. When first laid, eggs are not ready to hatch, but after several days a larva develops within each. When ready to hatch, larvae are extremely sensitive to disturbance, warmth or vibrations. When disturbed each larva pushes off the operculum, or lid, of the egg shell and wriggles out as fast as possible, groping upward for a hair or something to grasp. It remains in this questing attitude for many minutes, and resumes this attitude whenever disturbed further. Young larvae have been found in a wide variety of hosts, including dogs, cats, moles, domestic animals and even humans, but they do not develop further and soon die. Only in the mice mentioned above does further development occur, after a period of several days spent first in the mouse's trachea (a heavy infestation can cause asphyxiation), then following a rather circuitous route through the body of the mouse, finally coming to rest in the inguinal region. The developing larva perforates the skin to breathe, and as it grows, a pouch develops in the skin of the mouse to accommodate the enlarging larva. Development takes about three weeks. A fully mature larva, which is about two cm long, escapes by backing out through the tiny perforation in the skin. The host seems oblivious of this process, and can sometimes be seen dragging around a half-emerged larva. Larval exit is stimulated by the host's activity, probably to ensure that the larva is dropped on the forest floor and not in the host's nest where it would risk being eaten. The species overwinters as a puparium, and there is only a single generation per year in Nova Scotia, although other species farther south may have more than one annual cycle.

Family Sarcophagidae (flesh flies).

Most species of flesh flies look much alike; grey with three black longitudinal stripes on the thorax. All species are larviparous. Eggs passing from the ovaries are fertilized and stored in a bilobed pouch of the common oviduct which functions as a uterus. Larvae develop and hatch in the uterus, where they wait immobile until the female expels them onto some form of carrion or suitable host. Most species develop in carrion, some apparently showing a preference for dead snails, insects, millipedes or other invertebrates. A few species are parasitoids, developing in living insects, they are not true parasites, except perhaps when young, but apparently treat their hosts as carrion and destroy them quickly. One of the best known flesh fly parasitoids is *Sarcophaga aldrichi* Parker, a large species that attacks tent caterpillars, spruce budworm larvae and other caterpillars. During peak outbreak years adults of *aldrichi* may become so abundant in early summer that their persistent crawling over exposed skin in search of sweat becomes intolerable. A widespread belief that these flies are bred and released by some government agency is unfounded. Their abundance is one for the best known examples of an effective natural biological control agent in Canada. Another important sarcophagid in the Park is *Agria housei* Shewell, another parasitoid of spruce budworm, and probably other caterpillars as well.

An entire subgroup of sarcophagids, the subfamily Miltogramminae, has specialized in using as food the prey of wasps that provision their nests with insects and spiders. Adult female flies doggedly pursue wasps that have captured prey; when the wasp's attention is distracted momentarily while provisioning her nest, the fly larviposits on the prey. The young maggot of the miltogrammine destroys the wasp's egg and then proceeds to devour the prey. From the point of view of developing sarphagid larvae, adapted as a group to a diet of carrion, there may be little difference nutritionally between a dead insect, one paralyzed by a wasp but still alive, and a living insect.

At least 16 species of sarcophagids were collected in the Park, including the two above-mentioned parasitoids of spruce budworm. One of the most interesting was *Blaesoxipha fletcheri* Aldrich, whose larvae are scavengers in the leaves of pitcherplants. Presumably they feed on the dead insects trapped therein. Adults were taken in several of the bogs, and presumably are found throughout the Park, wherever pitcherplants grow. The larvae of *Boettcheria cimbicis* (Townsend) are parasitoids of the larvae of giant sawflies of the genus *Cimbex*, while those of *Helicobia rapax* (Walker) are scavengers in insect and other invertebrate carrion. Larvae of *Brachycoma setosa* Coquillett have been found in nests of bumble bees, where they are presumably scavengers, although it is quite possible that they destroy the developing bee larvae as well. Only three species of Miltogrammini were collected, *Metopia argyrocephala* (Meigen), *M. campestris* (Fallen), and *Amobia aurifrons* (Townsend).

Family Tachinidae (parasitic flies).

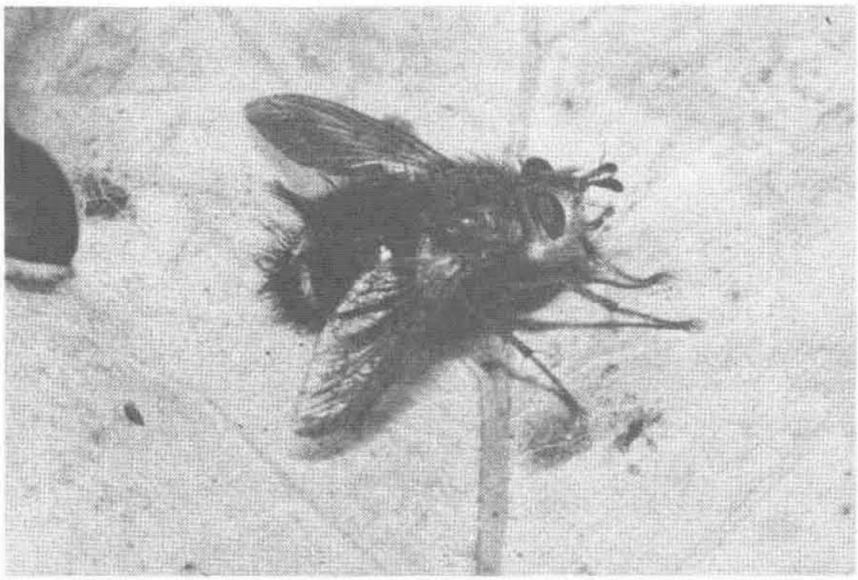


Fig. 10. *Epalpus signifer* (Walker). The most easily recognized species of tachinid in the Park, this large species is one of the earliest to appear in spring. The abdomen is black, with a transverse golden band on the last abdominal segment, hence its name *signifer* (sign-bearer). It is a parasitoid of cutworms.

Members of this family, one of the largest in the Diptera in terms of numbers of species, are one of the most important families economically, for the larvae of all species develop within the bodies of living insects, and a few related arthropods. Larvae almost invariably kill their host, and thus are classed as parasitoids, although when young, tachinid larvae are essentially parasitic, feeding on non-essential tissues, such as fat bodies and blood, doing no major damage to their hosts. Once they reach the last instar, however, they feed voraciously, destroying the host within a day or so. When they are finished feeding, they usually leave the carcass of the host and pupate in the soil. A few species pupate within the empty skin of the host.

The majority of tachinids, and probably the great majority in the Park, parasitize caterpillars, or larvae of Lepidoptera. Sawfly larvae, beetle larvae and adult beetles are also parasitized. Mechanisms of parasitism vary widely. A few species, presumed to be the most primitive, lay undeveloped eggs directly on the host, usually a caterpillar. The egg then undergoes embryonic development and the hatchling larva climbs out of the egg shell and burrows into the skin of the host. *Winthemia fumiferanae* Tothill, a parasite of spruce budworm, belongs to this group. This method of oviposition has drawbacks; hosts, particularly caterpillars, often destroy such eggs with their mandibles if they are within reach, so there is a strong tendency of females to oviposit on the host's head or near it. In addition, eggs may be lost when the host moults (this may be compensated for, in *Winthemia*, by the female being attracted by hosts that have just moulted). A third disadvantage is the inability of the female to lay more than a single egg at a time, and presumably several seconds or perhaps minutes must elapse before another egg decends the oviduct and is ready to be deposited. The majority of tachinids, however, have developed more complex strategies. Most species retain their eggs in a greatly expanded common oviduct, called the ovisac, or uterus, until many larvae are ready to hatch. Tachinid eggs do not hatch while still in the female (as do those of sarcophagids), but hatch immediately after they are laid, a process often termed ovolarviposition. Retention of eggs until larvae are ready to hatch may have two evolutionary advantages - the larva can penetrate immediately so the egg cannot be lost if the host moults, and the female can take advantage of host concentration if she should encounter it.

There are still further complex strategies, probably developed in response to aggressive, well-protected hosts, such as hairy caterpillars, or to hosts that are hidden. For example, most species of caterpillars hide during the day and feed at night; beetle larvae may spend their entire lives buried in soil or wood. Adult tachinids are almost without exception diurnal, and have no special adaptations to burrow or penetrate the substrate, but host contact is not necessary for several large, diverse groups, perhaps half the fauna of the Park. In one group, in the subfamily Goniinae, each female deposits thousands of minute eggs on foliage; each egg contains a larva ready to hatch but cannot do so until it is eaten by the host where digestive juices stimulate hatching. The first instar then burrows out of the gut and enters the body cavity of the host. This type of egg, called a microtype egg, is so small that it is scarcely visible to the unaided eye. Such an oviposition strategy may appear to be haphazard, but female flies do not broadcast their eggs carelessly but oviposit on recently damaged foliage of a suitable species of plant. Perhaps they can even sense the recent presence of a suitable host. The strategy is evidently successful for a large number of species have radiated within this group. Another large group in the subfamily Tachininae deposits normal sized eggs on foliage, but rather than being eaten, the egg hatches at once and the minute first instar waits for a host to pass by. It then hitches a ride, penetrating the host's cuticle immediately. A third group, in the subfamily Dexiinae, are parasites of hidden beetle larvae belonging to the families Scarabaeidae, Cerambycidae and other soil and wood-inhabiting forms. Females of this group broadcast their eggs on soil or wood in places likely to be frequented by suitable hosts; the eggs hatch immediately and the first instars burrow into the substrate in a presumably aimless search. The few that are lucky encounter a buried host before they dry out or die from lack of food.

At least 60 species were collected in the Park. This may represent no more than two thirds of the total fauna, but it is not possible to estimate the size of the fauna of a group in which species often become extremely rare because of the scarcity of their hosts. Because the spruce budworm population has been high for several years in Cape Breton, it was not surprising to find that nearly half of the specimens collected were parasitoids of the spruce budworm. Five of the eleven common parasites of this pest were collected in the Park, *viz, Actia interrupta* Curran, *Eumea cesar* (Aldrich), *Madremyia saundersi* (Williston), *Phryxe pecosensis* (Townsend) and *Winthemia fumiferanae*. The latter is the only one of the five that appears to be host specific to the spruce budworm; the rest have alternate hosts, so that their populations are not dependent on those of the budworm. *P. pecosensis* has a wide range of hosts, and is common throughout the summer all across Canada. The other three species, although found across the country, are much more subject to population fluctuations, and presumably have a narrower range of hosts and are consequently more dependent on budworm populations.

The most conspicuous tachinids in the Park are *Epalpus signifer* (Walker) (see Fig. 6) and the large shiny black species of the genus *Tachina* (subgenus *Nowickia*). These flies search for nectar on flower heads of cow parsnip, other white-flowered Umbelliferae, and yarrow, and may be seen commonly in various parts of the Park in early spring (*Epalpus*) or in July. They belong to the Tachininae whose larvae lie in wait for passing caterpillars; their hosts are probably cutworms and other noctuid caterpillars.

One of the most interesting tachinids collected was an undescribed species of *Lixophaga*. This fly is a parasite of the larva of the noctuid, *Exyra rolandiana* Grote, that closes off the openings in the leaves of pitcherplants to keep out rain water, then drains the fluid contents of the leaf before feeding on the leaf tissue beneath. Although specimens of the parasite have been reared from hosts collected from various bogs in Ontario and Quebec, these specimens are the first to be seen in nature. Both sexes were collected in French Lake bog, where males flew slowly over open patches of sphagnum, presumably searching for females.

Family Hippoboscidae (louse flies).

Members of this interesting family must occur in the Park but were not collected because proper techniques, involving trapping of birds, were not used. Adult louse flies are ectoparasites of birds and mammals. All the species in Eastern Canada, except the ked, or sheep-tick, *Melophagus ovinus* Linnaeus, infest birds. Their bodies are strongly flattened dorsoventrally and their legs project sideways like those of a crab, allowing them to slip between feathers. They have fully functional wings, and can readily transfer from one bird to another, or from prey to predator. Both sexes suck blood, and they insert the entire proboscis into the skin as do the stable fly and horn fly. The entire larval life is spent inside the female. Only one larva develops at a time in the uterus-like oviduct, and is nourished by secretions from the specially modified accessory glands. When the larva is fully grown, the female leaves its bird host and flies to an appropriate place on the ground to deposit the larva which promptly becomes a puparium. The female fly then finds a new host. An adult may develop in the puparium that same season, or the pupa may overwinter, emerging in spring in syncrony with returning spring migrants. Some species of louse flies must also travel south and north with their hosts during migration, for several species have wide distributions, occurring in both North and South America.

Keds, which are obligatory ectoparasites of sheep, have no wings, and presumably do not occur in the Park, although they may occur on sheep nearby. Birds which commonly support louse flies are ruffed grouse, song birds and hawks and owls. Herons and whipporwills each support their own species. At least four species are likely to occur in the Park, but collecting them is complex. Birds must be mist-netted, and without disturbing their feathers unduly, the entire bird except the head must be placed into a plastic bag containing a small amount of ether or similar anesthetic in a wad of cotton. This substance irritates the flies and as they try to escape from the feathers they are trapped in the bag and are overcome by the fumes. As long as the bird's head remains outside the bag, the treatment apparently does not harm the bird.

Order Siphonaptera (fleas)

by J.E.H. Martin

The fleas are small wingless insects that feed as adults on the blood of birds and mammals. The larvae live entirely free of the host, usually in its den or nest, where they feed on the excreted blood of the adult fleas and on other organic materials. Several species are annoying because of their bites, and a few are vectors of disease. They are commonly found on or in the nests of small rodents, which serve as hosts for by far the greater number of species. Some species are host specific being found on a particular bird or mammal and only occasionally straying to another, others feed on almost any hosts which occurs in their required environment. There are some 180 known species of fleas occuring in Canada, probably 30 or more of these occur in the Park. A new publication on the Siphonaptera of Canada, Alaska, and Greenland by G.P. Holland is available and information on the species that occur or likely to occur in the Park can be obtained from this source.

Reference

Holland, G.P. 1985. The fleas of Canada. Alaska and Greenland (Siphonaptera). Ent. Soc. Can. Mem. 130.

Order Lepidoptera

by K.B. Bolte, P.T. Dang, D.H. Kritsch,
J.D. Lafontaine, R.A. Layberry and A. Mutuura

Introduction

The order Lepidoptera, which includes the butterflies and moths, is one of the best known and most extensively collected of the insect orders that occur in Nova Scotia.

The provincial fauna was extensively treated in *The Lepidoptera of Nova Scotia* by D.C. Ferguson (1954), which listed known collecting localities for each species, as well as information on season, habitat and larval host plants. This information has been augmented by additional collecting since 1954, especially through the efforts of D.C. Ferguson, B. Wright and K. Neil. Most collections, however, have been made in the regions around Halifax, Truro, and the Agriculture Canada Research Station at Kentville. Cape Breton Island remains relatively poorly collected except for the vicinity of Baddeck.

Traditionally, the order Lepidoptera has been divided into either the butterflies and moths, or into macrolepidoptera (butterflies and larger moths) and microlepidoptera (smaller moths). More recent evolutionary classifications, however, do not recognize either of these systems; although they are often used for convenience.

The butterflies and the dominant families of medium-sized and large moths, particularly the cutworm moths (Noctuidae), tiger moths (Arctiidae), inchworm moths (Geometridae), silk moths (Saturniidae) sphinx moths (Sphingidae) and leaf roller and budworm moths (Pyralidae and Tortricidae) are now relatively well-collected in Cape Breton Highlands National Park and in most of these groups between 1/2 and 2/3 of the species that could be expected to occur in the Park were actually found. The adult moths of these families can be effectively collected with a net during the day, or with a light trap, or a light on a collecting sheet, at night. In addition, most species in these groups can be identified and the habits and range of most are well known.

The small microlepidoptera, on the other hand, are poorly known because they are difficult to collect and identify. Families such as the Tineidae, Gracillariidae, and Coleophoridae may include several hundred species in the Park but the adults are small and delicate with wings often only 3 or 4 mm long. They can effectively be collected only by very specialized techniques that involve locating suitable larval host plants, searching for larval mines within the leaves, or cases on the leaf surface, and by rearing the adults out individually. These groups also include many undescribed species and the distribution of those that are described are frequently poorly known. As a result, the leaf mining microlepidoptera remain poorly known and the Park fauna can only be described in general terms.

Illustrations and further information on many of the species that occur in the Park can be found in Morris (1980), *Butterflies and Moths of Newfoundland and Labrador* and Covell (1984) *A Field Guide to the Moths of Eastern North America*.

The following table summarizes the number of species known and expected to occur in Cape Breton Highlands National Park.

Census of Cape Breton Highlands National Park Lepidoptera

Superfamily	No. species known in Eastern Canada	Est. species in Park	Species known from Park
Micropterigoidea	1	1	0
Eriocranioidea	1	1	0
Hepialoidea	8	2	0
Nepticuloidea	40	20	0
Incurvarioidea	21	2	0
Tineoidea	124	50	1
Gelechioidea	227	100	5
Copromorphoidea	7	5	1
Yponomeutoidea	34	20	4
Sesioidea	32	5	0
Tortricoidea	425	150	50
Cossoidea	3	3	0
Hesperioidea	38	10	9
Papilionoidea	112	38	26
Zygaenoidea	14	3	0
Pterophoroidea	26	12	1
Pyraloidea	200	75	22
Geometroidea	280	154	76
Bombycoidea	15	7	3
Sphingoidea	44	14	7
Noctuoidea	782	372	196
Total	2434	1044	401

In the following pages, we summarize information on each of the superfamilies of Lepidoptera that occur in Cape Breton Highlands National Park. For most families only species of particular interest or importance are discussed. A species-level treatment is provided for three groups that contain large, showy species; these are the butterflies (superfamilies Hesperioidea and Papilionoidea), the silk moths and tent caterpillar moths (superfamily Bombycoidea) and the hawk moths or sphinx moths (superfamily Sphingioidea).

Microlepidoptera

by P.T. Dang and A. Mutuura

Microlepidoptera includes mostly minute-sized moths with the forewing seldom exceeding 15 mm in length. Generally, Microlepidoptera has been poorly known and collected, especially in the leaf-miner group, mainly due to the small size of both adults and larvae. Also, collecting and mounting microlepidopterous specimens are time consuming and difficult; most microlepidopterous moths are nocturnal and yet many of them are not readily attracted to light at night and then they are easily damaged because of small size. Therefore, collecting Microlepidoptera with light traps is not always a satisfactory approach. The process of collecting larvae and rearing them to adults often yields good results; however, it takes a great amount of time and labor, and many workers avoid this approach. In the Maritime Provinces, the Microlepidoptera is very poorly collected with few existing records. However, the number of microlepidopterous species expected to occur in the CBHNP and surrounding provinces is not much different from that in other eastern regions of Canada. In Ontario and Quebec, on the other hand, collecting efforts on this particular group of insects have been fairly extensive, and therefore, the number of recorded species in these areas is fairly moderate, and some widespread species recorded in these two provinces would be expected to occur in the CBHNP.

There are over 5,000 described microlepidopterous species in North America, most of which are of little economic importance, however, some are serious pests, causing severe damage to forests and agricultural crops in Canada and the United States.

In the Cape Breton Highland National Park, species of Microlepidoptera can be found virtually in almost every habitat, including shore line vegetation, barren and boggy areas, and lowland deciduous and boreal coniferous forests.

Superfamily Micropterigoidea

by P.T. Dang

Number of Micropterigoid species recorded in North America is 2, of which one occurs in eastern Canada. *Epimartyra auricrinella* Walsingham (Micropterigidae) represents the most primitive species of Lepidoptera found in eastern Canada. The adult is a dayflyer and a pollen feeder with well-developed and functional mandibles; the larva feeds on moss and liverwort on the forest floor. The species appears to be quite rare and has not been recorded east of Quebec province. However, the CBHNP habitats are obviously very likely to support this species.

Superfamily Eriocranioidea

by P.T. Dang

The number of Eriocranioid species recorded in North America is 15, in eastern Canada 1. *Eriocrania semipurpurella* (Stephens) (Eriocraniidae), another primitive Lepidopterous species of European origin, occurs in eastern

Canada, from Ontario to Halifax, Nova Scotia. The larva is a leaf miner of various species of *Betula*. The species is highly expected to occur in the CBHNP.

Superfamily Hepialoidea

by P.T. Dang

The number of Hepialoid species recorded in eastern Canada is 8, in North America 20. Adults of Hepialoidea are large, heavy bodied, with the forewing reaching 50 mm in length. Larvae are root borers of various tree species such as willow, poplar, alder, etc. *Sthenopis argenteomaculatus* (Harr.) and *S. quadriguttatus* (Grt.), widely distributed in Canada, are the largest species of the family Hepialidae. No species of Hepialidae has as yet been recorded in the CBHNP.

Superfamily Nepticuloidea

by P.T. Dang

The number of Nepticuloid species recorded in eastern Canada is 40, in North America 150. Nepticuloid moths are minute to small, dark in colour with iridescent markings, or yellowish brown to dark brown without distinct markings. Larvae are leaf, bark and fruit miners, and a few are gall producers. Most Nepticuloids are of no economic importance. They are very poorly collected and almost unkown to the province of Nova Scotia. However, the CBHNP habitats are quite likely to support this group.

Superfamily Incurvarioidea

by P.T. Dang

The number of Incurvarioid species recorded in eastern Canada is 10, in North America 60. Adults are brightly coloured dayflying moths. Larvae are leaf or stem miners of various deciduous trees, shrubs and herbaceous plants. They are of no economic importance. The raspberry budmoth, *Incurvaria rubiliella* (Bjerk.)(Incurvariidae, Incurvariinae), an introduced species from Europe and widely distributed in eastern Canada, and *Adela purpurea* Walker (Incurvariidae, Adelinae), a caddisfly-like moth with exceptionally long antennae (more than 3 times the body length) and commonly found in Ontario and Quebec, are likely to occur in the CBHNP.

Superfamily Tineoidea

by P.T. Dang

The number of Tineoid species recorded in eastern Canada is 124, in North America 594. Tineoid moths are small to minute in size, with narrow, lanceolate wings usually with bright iridescent markings. Only the bagworm moths (Psychidae) are much larger in size and with much broader wings. Larvae are leaf, stem, or bark miners of mainly deciduous trees, shrubs, herbaceous plants (Gracillariidae), scavengers on decaying plant and animal material (Tineidae), or case bearers (Psychidae). A number of species of this superfamily are pests of trees, shrubs and stored products. *Solenobia walshella* Clemens (Psychidae), distributed from Ontario to New Brunswick, and the introduced European species *Psyche casta* (Pallas) (Psychidae), found in Ontario and Quebec on coniferous and deciduous trees, *Bucculatrix canadensisella* Chamber (Lyonetiidae), commonly known as the birch leaf skeletonizer, widely distributed across Canada and a major pest of birch, and a number of species of *Caloptilia* Hubner and *Phyllonorycter* Hubner (Gracillariidae), often with bright golden brown forewings with iridescent white markings and represented by the well-known pest of apple *Phyllonorycter blancardella* F., an introduced species from Europe, are highly expected to occur in the CBHNP. *Monopis spilotella* Tengtrom (Tineidae) of European origin and widely distributed in Canada, has recently been collected in the CBHNP.

Superfamily Gelechioidea

by A. Mutuura

Two hundred and twenty-seven species of Gelechioidea have been found in eastern Canada out of a North American total of 1,460. Most gelechioid moths are very small in size. The larvae may be leaf miners (families Elachistidae and some Coleophoridae and Cosmopterigidae), case bearers (most Coleophoridae), or twig tiers and leaf rollers (families Oecophoridae and Gelechiidae). Some species of the family Gelechiidae are pests of dried seeds, grain and other stored products.

Five species have been recorded from the Park but as many as a hundred species could possibly occur. The five recorded species include two in the family Oecophoridae (*Bibarrambla allenella* (Wlshen), which feeds on alder and birch, and *Psilocorsis cryptolechiella* Clem., which feeds on beech), two in the Coleophoridae (*Coleophora serratella* (L.), which feeds on birch, and *C. laricella* (Hbn.), which feeds on tamarack) and one species of the family Gelechiidae (*Anacampsis innocuella* Zell., which feeds on poplar and birch). These species probably occur throughout the Park wherever the larval food plant grows.

Superfamily Copromorphoidea

by A. Mutuura

The Copromorphoidea is a small group in Canada with only 7 recorded species; 35 are known from North America. The moths of this superfamily are all small in size. The larvae may live in flowers (family Alucitidae), or may be internal feeders in fruit or galls (family Carposinidae). Other groups form webs around flower heads and feed on the developing seeds (family Epermeniidae) or may be root borers (family Glyphipterigidae). In Cape Breton Highlands National Park, one species of the family Carposinidae, *Bondia comonana* (Kft.), is known to occur, but several species in the families Epermeniidae and Glyphipterigidae probably also occur in the Park.

Superfamily Yponomeutoidea

by A. Mutuura

Thirty-four species of yponomeutoid moths have been found in eastern Canada, out of a total of 168 for all of North America. The moths are generally small in size with long, narrow wings. Many species are diurnal while others are readily attracted to lights at night. The larvae of members of the family Argyresthiidae are twig, bud and fruit borers, or may mine leaves and needles in deciduous and coniferous trees. Other larvae feed in webs on the leaves of various trees, shrubs and herbaceous plants (families Yponomeutidae and Plutellidae), bore in the stems or bulbs of Liliaceae (family Acrolepiidae), or produce galls and mines in the leaves of various deciduous plants (family Heliodinidae).

Four species of Yponomeutoidea have been recorded from the Park but as many as twenty may occur there. The four species include three species of *Argyresthia* (*A. laricella* Kft. on tamarack, *A. goedartella* (L.) and *A. oreasella* Clem.), and one species of *Plutella* (*P. xylostella* (L.)).

Superfamily Sesioidea

by P.T. Dang

The number of Sesioid species recorded in eastern Canada is 23, in North America 145. Sesioid moths are quite distinct from other Lepidoptera, having transparent and apparently scaleless wings and brightly coloured bodies in the family Sesiidae (commonly known as the clearwing moths), or with fully scaled wings and sharply contrasting iridescent markings in the family Choreutidae. Larvae are root or stem borers of various coniferous and deciduous trees, shrubs and herbaceous plants (Sesiidae), or external feeders, miners in early instars in some cases (Choreutidae). Clearwing moths fly during the day among flowers of the host plants, strikingly mimiking wasps in both appearance and behaviour. *Synanthedon pini* (Kellicott) (Sesiidae) (spruce and pine borer), commonly found in Ontario, *Pennisettia marginata* (Harris) (Sesiidae), also known as the raspberry crown borer and commonly found in eastern Canada including Nova Scotia, *Choreutis diana* (Hubner) (Choreutidae), a widespread holarctic species recorded from British Columbia to Newfoundland, *Prochoreutis inflatella* (Clemens) (Choreutidae) and *Tebenna onustana* (Walker) (Choreutidae), commonly found in eastern Canada including Nova Scotia, are highly expected to occur in the CBHNP.

Superfamily Cossoidea

by P.T. Dang

The number of Cossoid species recorded in eastern Canada is 3, in North America 45. Cossoid moths are medium to large size with stout and heavy body usually with dull colours and mottled patterns on the forewing; the hindwing is small in relation to the forewing and the body. The moths are often wellcamouflaged, resting on the trunk of the host tree. Larvae, also known as carpenterworms, are borers of various deciduous trees, shrubs and herbaceous plants, and at times can become serious pests. *Prionoxystus robiniae* (Peck), *Acossus centerensis* (Lint.), and *A. populi* (Walker) (Cossidae) commonly recorded in eastern Canada, are expected to occur in the CBHNP.

Superfamily Tortricoidea

by P.T. Dang

The number of Tortricoid species recorded in eastern Canada is 425, in North America 1,162. Torticoid moths are of small to medium size, with the forewing 5 - 15 mm in length. Larvae are mostly external feeders of the foliage of coniferous and deciduous trees, shrubs and herbaceous plants; some are stem, trunk or fruit borers; some seed feeders, and a few are leaf or needle miners at early stages. Tortricoid species constitute one of the largest and most important groups in the Microlepidoptera, many of them being serious pests inflicting tremendous damage and loss in forests and agricultural crops in Canada and the United States. Because of the great economic importance of this group, Tortricoid species have been among the most extensively collected insects across the North American continent. The superfamily comprises 2 families, the Tortricidae and the Cochylidae.

Family Tortricidae

The number of Tortricid species recorded in eastern Canada is 400, in North America 1,053. Tortricid moths, commonly known as the leafrollers, are the most common species found attracted to light at night among species of Microlepidoptera. Some are very showy and colorful. During the day the moths can also be seen fluttering about around the host plants especially when the sky is overcast or when the resting place is being disturbed. They are easily recognizable by the shape of the forewing in which the truncated apex often gives the moths at rest a characteristic bell-shaped appearance. The colour and pattern of the forewing of the tortricid moths vary greatly from plain white, orange, reddish brown or dark brown, and immaculate, to orange, reddish brown or dark brown with series of oblique bands or with numerous irregular dark and pale spots in place of those bands.

Most Tortricid species found in the CBHNP are pests, a few very destructive and of great economic importance. The following species have been actually recorded in the CBHNP; species expected to occur in the Park but not yet recorded are marked with an asterisk (*). The spruce budworm, *Choristoneura fumiferana* (Clemens) has been notoriously known as the most destructive pest in conifer forests in eastern Canada. It has already marked its devastating presence in the CBHNP where over 60% of spruce and fir forests are badly damaged. Besides, several other Tortricid species at times are also very damaging to the spruce and fir forests in the CBHNP, including the spruce budmoths *Zeiraphera canadensis* Mutuura & Freeman, *Z. unfortunana* Powell, the black headed budworm, *Acleris variana* (Fernald), *Archips packardiana* (Clemens), *A. alberta* (McDunough), and *A. striana* (Fernald). The eyespotted budmoth, *Spilonota ocellana* (Denis & Schiffermuller), a widely distributed species in the holarctic region, and the larch budmoth, *Zeiraphera improbana* (Walker), are pests of tamarack, the former also attacking apple. *Choristoneura pinus* Freeman, commonly known as the jack pine budworm, closely allied to the spruce budworm, was found in the isolated jack pine forest in the Park. This species is commonly found associated with jack pine in eastern Canada. Major pests of poplar, maple, basswood, birch and other deciduous trees commonly found in the CBHNP include the fruittree leafroller *Archips argyrospila* (Walker), *Archips cerasivorana* Fitch*, *A. mortuana* Kearfott, *A. purpurana* Clemens, *A. rosana* Linnaeus, *Pandemis lamprosana* Robinson, the obliquebanded leafroller *Choristoneura rosaceana* (Harris), the large aspen tortrix, *C. conflictana* Walker*, *C. fractivittana* (Clemens), *Clepsis persicana* Fitch, the spotted aspen leafroller, *Pseudosciaphila duplex* Walsingham, the yellow headed aspen leaftier, *Epinotia nisella* Clerck*, *E. crenana* (Hubner), *Orthotaenia undulana* (Denis & Schiffermuller) (this common and widespread species in Canada was introduced from Europe), *Apotomis youngana* (McDunough), *Hedya nubiferana* (Haworth), *Proteoteras moffatiana* Fernald, *Sparganothis reticulana* (Clemens), *S. pettitana* (Robinson)*. Pests of herbaceous plants such as strawberry, blueberry, raspberry etc., include *Clepsis clemensiana* (Fernald), *Cnephasia stephensiana* (Doubleday), *Ptycholoma peritana* (Clemens), *P. virescana* Zeller, *Olethreutes olivaceana* (Fernald), *O. bipartitana* (Clemens), *Orthotaenia undulana* (Denis & Schiffermuller), *Croesia curvalana* Kearfott. The number of Tortricid species actually recorded in the CBHNP as mentioned above only represents a small portion of the Tortricid family, the expected number of species of this group to occur in the CBHNP no doubt being much greater and probably with many undescribed species. None of the known Tortricid species in Canada was described from specimens collected from the CBHNP.

Family Cochylidae

The number of Cochylid species recorded in eastern Canada is 25, in North America 110. Moths of this family are often of small size and generally resemble the Tortricid moths. The larvae are mainly seed feeders associated with plants of the family Compositae (aster, sunflower, etc.). The family is very poorly known, with a great number of undescribed species and with many described species with unknown status. The family has been poorly collected in eastern Canada, and there are no actual records of the Cochylidae in the CBHNP. The widespread European species in eastern Canada, *Aethes rutilana* (Hubner), a needle miner of native juniper in Canada, and the banded sunflower moth, *Cochylis hospes* Walsingham, an important pest of cultivated sunflower, are likely to occur in the CBHNP.

Superfamily Zygaenoidea

by A. Mutuura

Nine species of zygaenoids have been found in eastern Canada. The group is primarily tropical; although 87 have been found in the United States. The moths occur in two basic forms that correspond to the two families. Zygaenids are medium-sized moths with long, narrow wings and diurnal flight; limacodids are medium-sized, stout bodied moths with short broad wings and nocturnal flight. Members of the Limacodidae are commonly called slug caterpillar moths because of the peculiar shape of the larvae. Three species of Limacodidae are common in eastern Canada, including Nova Scotia, and probably occur in Cape Breton Highlands. These are *Tortricidia testacea* Pack., *T. flexuosa* (Grt.) and *Lithacodes fasciola* (L.-S.).

Superfamily Pterophoroidea

by A. Mutuura

This group of moths is commonly called plume moths because the forewing is cleft into two feather-like lobes and the hind wing into three. Twenty-three species have been recorded in eastern Canada and 146 are known from North America. The larvae feed in rolled leaves, in buds, or bore in stems. Only one species, *Oidaematophorus homodactylus* (Wlk.), is known from the Park but as many as a dozen are expected to occur.

Superfamily Pyraloidea

by A. Mutuura)

Over 200 pyraloid moths have been recorded in eastern Canada and 1,387 are known from North America. The moths are variable in size, appearance, and structure; usually, however, the forewings are elongated and triangular and the hind wings are broad. Some groups, however, have very slender forewings. In Canada, the superfamily is represented by two families: the Thyrididae and Pyralidae. Most species are nocturnal. Larvae vary widely in habit; they may be webbers, leaf-tiers, leaf-rollers, leaf-miners, or borers of shoots, bark, cones, seeds, stems, roots and tubers. The larvae of members of the subfamily Nymphalinae are aquatic and feed on the leaves and stems of aquatic plants. Many species of the subfamily Crambinae are sod feeders and are known as webworms. The adults are frequently marked with white and silver and sit during the day on blades of grass with the wings wrapped around the body. They are easily observed during the day since they take flight when disturbed and are abundant in grassy areas of the Park such as the dune areas near the Park Operations building. Species of Crambinae that were collected in the Park are *Crambus perlellus* (Scop.), *C. leachellus* (Zinck.), *C. albellus* Clem., *C. girardellus* Clem., and *Pediasia trisecta* (Wlk.).

One species of the subfamily Scopariinae, *Scoparia basalis* Wlk., was collected; the larva feeds on mosses.

The subfamily Phycitinae includes many species with larvae that feed on the foliage of trees. They include: *Acrobasis betulella* Hulst and *Ortholepis passadina* (Dyar) on birch, *Glyptocera consobrinella* (Zell.) on maple, *Meroptera pravella* (Grt.) on poplar, and *Dioryctria reniculelloides* Mut. & Mun. on spruce.

The subfamily Pyraustinae includes the economic pest *Ostrinia nubilalis* (Hbn.), the European corn borer. Occurrence of this species in the Park represents the northernmost record for the species in North America. Other pyraustines collected were *Mutuuraia mysippusalis* (Wlk.), *Udea rubigalis* (Gn.), *Nomophila nearctica* Mun. and *Herpetogramma pertextalis* (Led.).

Superfamily Geometroidea

by K.B. Bolte

The Geometroidea is the second largest superfamily in the order with over 1,500 species known to exist in North america. Most of the species are known as inch worms, loopers, span worms or measuring worms and belong to the family Geometridae.

Other eastern Canadian species are arranged in two small families: hooktip moths (family Drepanidae), and the family Thyatiridae.

The superfamily is characterized by the position of the tympanic organ, in adults, which opens subventrally below the spiracles at the base of the abdomen. The Cape Breton Highlands National Park fauna is discussed below under the individual families.

Family Geometridae

Adult geometrids are a variety of colours including white, black, brown, yellow, green and pink. Most are thin-bodied with broad delicate wings; they generally rest with their wings at right angles to the body. They are varied in size from quite small to large and most are attracted to lights at night; however, some species, like *Rheumaptera hastata* (L.), are day flyers. The larvae can be found feeding on vegetation during the day and are easily recognized by their 2 pairs of prolegs at the back and the usual 3 pair of thoracic legs at the front which produces a looping type locomotion. Most of the larvae are twig mimics.

In Cape Breton Highlands National Park, 73 species have been recorded and about 150 can be expected to occur. The varied habitats of the Park are anticipated to support about 55% of the eastern Canadian fauna. Most of the eastern Canadian species are relatively well known; about 99% of the species in the Park have been named on the basis of adults; however, less than 70% of the larvae of species in the park have been described.

The larvae of geometrid species are generally forest tree feeders and some can be considered pests; they are all solitary feeders. No serious pest species were collected in the Cape Breton Highlands National Park survey; however, it would not be unlikely if the following pests are present: *Operophtera brumata* (L.), an introduced species; *Operophtera bruceata* (Hlst.); *Alsophila pometaria* (Harris), a general hardwood feeder; and *Lambdina fiscellaria fiscellaria* (Guenée), a hemlock feeder. Other larvae feed on a wide variety of plants and include: *Mesoleuca ruficillata* Guenée, a raspberry leaf feeder; *Ematurga amitaria* (Guenée), the cranberry span-worm, occasionally injurious to cranberry; and *Xanthotype urticaria* Swett, which has been found feeding on mint among other plants.

Some of the most common and easily recognized adults are the pepper-and-salt moth, *Biston betularia cognataria* (Guenée), a large black and white moth, and *Campaea perlata* (Guenée), a relatively large white moth with delicate looking wings. Bog habitats in the Park support several local species such as *Eufidonia discospilata* (Walker), a small off-white moth with heavy grey-brown markings, and *Ematurga amitaria* (Guenée), a larger predominantly light brown moth. Some of the more colourful species found in the Park are *Xanthotype sospeta* (Drury), an almost completely yellow moth; *Trichodezia labovittata* (Guenée) and *Rheumaptera hastata* (Linnaeus), both strikingly contrasting black and white moths; and *Synchlora aerata albolineata* Packard, an almost completely green moth.

Some species such as *Euchlaena obtusaria* Hubner and *Euchlaena madasaria* (Walker) overwinter in the larval stage; others such as *Dysstroma hersiliata* (Guenée) overwinter in the egg stage; however, most species overwinter in the pupal stage.

Family Drepanidae

This is a small group of geometrid-like moths. The adults are thin bodied with delicate wings and they generally rest with their wings folded over their abdomen. They are varied in size from small to medium and are attracted to lights at night. The larvae can be found feeding on vegetation during the day. They have 4 pairs of abdominal prolegs and the usual 3 pairs of thoracic legs along with a pair of vestigial anal prolegs which when combined with the elongated caudal segments gives the appearance of a lizard-like tail.

Three of the 5 eastern Canadian species have been found in Cape Breton Highlands National Park. Both adults and larvae of all eastern Canadian species are known. The larvae are generally forest tree feeders and none is considered to be a pest; they are all solitary feeders.

The adults of the three species found all have the fore wings with more or less prominent hooked tips. The most colourful species found in the Park is *Oreta rosea americana* (H.-S.), which has shades of orange and light brown with a broad longitudinal band of bright yellow bisecting the wings. The most common species in the park is *Drepana arcuata* Walker.

Family Thyatiridae

This is a small group of noctuid-like moths which have thick bodies and elongated wings which are folded in a roof-like manner when the adult is at rest. They are medium in size and can be found flying in the daytime. The larvae feed on vegetation during the day. They are hairless and often conceal themselves in a case made by loosely fastening together leaves or by folding a single leaf.

In Cape Breton Highlands National Park 3 of the 4 eastern Canadian species which can be expected to occur, have been recorded. The larvae feed on the leaves of forest trees and shrubs and none is considered to be a pest; they are all solitary feeders. The adults are generally marked with conspicuous wavy and zigzag lines.

Superfamily Bombycoidea

by D.H. Kritsch

Family Saturniidae (giant silkworm moths)

Moths belonging to the family Saturniidae are characterized by their large size, ornately-decorated wings and, in the case of the males, by their long, tapering, plumose antennae. Approximately 600 species encompassing 65 genera are found in the New World while in America north of Mexico, about 65 species and 18 genera are established. Ferguson (1954) recorded 6 species of Saturniidae from Nova Scotia and of that number, 2 species had been collected in Cape Breton. In the CBHNP Survey (1983-84), one species *Antheraea polyphemus* (Cramer) was collected while *Dryocampa rubicunda* (Fabricius) and *Hyalphora columbia* (S.I. Smith) are expected to occur in the Park.

The Saturniidae, due to their striking maculation and large size, are the most conspicuous of all moths. Two of the largest moths that occur in North america, namely *Hyalophora cecropia* (L.) and *Antheraea polyphemus* (Cramer), belong to the family Saturniidae. Due to their apparent conspicuousness, the Saturniidae have become easy prey for numerous bird and insect predators. In response to this threat, some Saturniid adults have developed eye-spots or lunules on their hind wings to frighten threatening birds. Also, some Saturniid larvae possess conspicuous eye-spots to alarm predators while others employ poisonous spines to discourage threatening predators.

However, in spite of these ingenious defensive mechanisms, the Saturniidae population, under normal conditions, continues to be held in balance by birds and insect parasites.

The following is a list of the Saturniidae that have been collected in CBHNP as well as those that could be expected to occur there. Additional biological data are included with this list.

Dryocampa rubicunda (Fabricius) (rosy maple moth, green-striped mapleworm)

The larva feeds on red maple, sugar maple, silver maple and oak. It has been recorded from many localities in Nova Scotia, including Whycocomagh and Baddeck and it probably occurs in CBHNP. In Nova Scotia, adults fly from May through August.

Hyalophora columbia (S.I. Smith)

The larva feeds exclusively on tamarack or eastern larch (*Larix laricina* (DuRoi) K. Koch). Adults may be common locally but are rarely encountered. It probably occurs in CBHNP June-July.

Antheraea polyphemus (Cramer)

Fig. 11 Polyphemus moth male (*Antheraea polyphemus*)

The larva feeds on a variety of broad-leafed trees including birch, willow, alder, maple, cherry, hawthorn, oak, poplar, basswood, hop-hornbeam, beech, elm, dogwood and serviceberry. Specimens were collected in CBHNP in 1983 and 1984 from the following localities: Cheticamp Campground, Pleasant Bay, Black Brook Campground. The adults fly in June and July.

Family Lasiocampidae (tent caterpillar moths)

The family Lasiocampidae is comprised of medium-sized moths characterized by subdued maculation, drab colours and short, blunt bodies. The family contains two of the most conspicuous and well-known members of the order Lepidoptera, namely the eastern tent caterpillar (*Malacasoma americanum* (Fabricius)) and the forest tent caterpillar (*Malacosoma disstria* Hubner). Although individual members of the family are numerous in Nova Scotia, few species actually occur there. Of the five species that occur in Nova Scotia, two species has been recorded from CBHNP while another two species probably occur there. The list of species, with additional biological data is as follows:

Tolype laricis (Fitch)

The larva has been found on pine, tamarack, spruce, balsam fir and eastern hemlock. Adults have been recorded throughout Nova Scotia including Cape Breton Highlands National Park. The adults occur from July to October.

Phyllodesma americana (Harris) (lappet moth)

The larva feeds on oak, poplar, aspen, willow, birch and certain Rosaceae. It probably occurs in CBHNP. The adults occur from mid-May until July.

Malacosoma disstria Hubner (forest tent caterpillar)

The larvae do not construct a tent but form a mat-like structure out of silk that is woven across several branches. At dusk, all of the larvae congregate on this mat.

The larva is blue on the sides of the back with distinct white dorsal dots. It feeds on a variety of trees and shrubs including aspen. white birch, sugar maple, willow, red oak, chokeberry speckled alder, serviceberry etc. This species fluctuates in abundance and can build up in numbers to be a major forest pest.

It is found throughout Nova Scotia and has been collected at Pleasant Bay and Cheticamp Campground in CBHNP. Adults fly in July.

Malacosoma americanum (Fabricius) (eastern tent caterpillar)

The larvae construct a silken tent in the crotch of a tree or shrub that is supported by two or three strong branches. During the day, the larvae leave the tent to feed but return to the tent at dusk.

The larva is almost black with a conspicuous white dorsal stripe running the length of the body.

The larvae feed on pin cherry, chokeberry, apple, trembling aspen, black cherry, white birch, hawthorn, silver maple, red oak, largetooth aspen, hazel, willow, white oak and other trees. Adults are found throughout Nova Scotia and probably occur in CBHNP during July and early August.

Superfamily Sphingoidea (hawkmoths)

by D.H. Kritsch

Family Sphingidae

The family Sphingidae is comprised of medium to large-sized moths characterized by long tapering wings and bullet-shaped abdomens. Hodges (1971) cites approximately 1,000 species in the world including 40 genera and 115 species that occur in America north of Mexico. Ferguson (1954) recorded 26 species of Sphingidae from Nova Scotia of which 13 were recorded from Cape Breton Island. It is probable that these 13 species occur in Cape Breton Highlands National Park. At present, 5 species of Sphingidae have been recorded from Cape Breton Highlands National Park.

Although most species are either crepuscular or nocturnal, some species are diurnal. A number of peculiar defensive mechanisms are employed by certain Sphingid species and these include *Hemaris* spp., which mimic bees, *Smerinthus* spp., which expose threatening eye-spots located on the hind wings to frighten menacing birds, and *Sphinx* spp., which camouflage themselves against the trunks of trees by utilizing irregular wing patterns and colours that blend with the bark. Thus, by employing protective patterns and unique behavioural traits, certain adult sphingid species are able to escape detection by predators.

Sphingid larvae, called hornworms, can be easily distinguished from other Lepidoptera larvae by the presence of a conspicuous anal horn located at the end of the body. The larvae can be found during the summer months feeding on a variety of deciduous trees and shrubs and in one case (*Lapara bombycoides* Wlk.), on white pine. In later instars, the larvae are so large and conspicuous that parasitism can sometimes be quite high. That factor, combined with other controlling factors exerted on the larval population by birds and diseases, tend to keep the Sphingid populations relatively low so that major infestations are rare.

The following is a list of Sphingidae that have been collected in Cape Breton Highlands National Park as well as those that could be expected to occur. Additional biological data are included with this list.

Ceratomia amyntor (Geyer)

Specimens were collected in Cape Breton Highlands by the Forest Insect Survey. The larva feeds primarily on elm but have also been found on birch, basswood and cherry. The adults occur in July.

Ceratomia undulosa (Walker) (waved sphinx)

The larva feeds primarily on ash but can also be found on other trees. Two specimens were collected in CBHNP in July of 1983 (1 at Pleasant Bay; 1 at Black Brook Cove).

Sphinx kalmiae (J.E. Smith)

The larva feed on ash and poplar. Three specimens were collected at CBHNP in July of 1983 (2 at Pleasant Bay; 1 at MacIntosh Brook Campsite).

Sphinx poecila (Stephens)

The larva feeds on a variety of trees and shrubs including apple, ash and blueberry, tamarack and white spruce sweetfern.. The species is common throughout Nova Scotia. It has been collected in CBHNP at Pleasant Bay, Mackenzie Fire Tower, Ingonish, North Mountain bog and Black Brook Cove. Adults occur in June and July.

Lapara bombycoides Walker

The larva feeds on white pine. The species occurs throughout Nova Scotia but has not yet been found in the Park. Adults fly in June and July.

Smerinthus jamaicensis (Drury) (twin-spot sphinx)

The larva has been recorded from poplar, birch, willow, elm, ash, apple and plum. It has been collected throughout Nova Scotia and probably occurs in CBHNP. Adults occur from May until August.

Smerinthus cerisyi (Kirby)

The larva has been reared on willow and poplar. The species is common throughout Nova Scotia and probably occurs in CBHNP. The adults fly in June and July.

Paonias excaecatus (J.E. Smith) (blind-eyed sphinx)

The larva feeds on willow, hornbeam, oak, apple, cherry, serviceberry, hawthorn, rose, poplar, birch, elm and basswood. The species is common throughout Nova Scotia. It was collected in CBHNP at North Mountain bog, Cheticamp, Pleasant Bay, Ingonish, MacIntosh Brook Campsite and on Mackenzie Mountain. It occurs in June and July.

Paonias myops (J.E. Smith) (small-eyed sphinx)

The larva has been reared on chokeberry, black cherry, serviceberry and wild grape. The species probably occurs in CBHNP.

Pachysphinx modesta (Harris) (big poplar sphinx)

The larva feeds on willow and poplar. It probably occurs in CBHNP.

Hemaris thysbe (Fabricius) (humming-bird moth, common clearwing)

The larva has been found on hawthorn, cherry, plum, honeysuckle and snowberry. Adults were found in CBHNP at French Lake Bog as they pollinated the flowers of the white fringed orchid (*Platanthera blephariglottis*).

Hemaris diffinis (Boisduval) (snowberry clearing)

The larva feeds on dogbane, snowberry and honeysuckle. The moth was collected in CBHNP on French Mountain.

Dorapsa pholus (Cramer) (Azalea sphinx)

The larva feeds on *Viburnum*. An adult was collected at the Mackenzie Mountain Fire Tower in June.

Hyles gallii (Rottenburg)

The larva feeds on willow herb (*Epilobium* spp.) and bedstraw (*Galium* spp.). It has been recorded throughout Nova Scotia and probably occurs in CBHNP.

Superfamily Noctuoidea

by J.D. Lafontaine

The Noctuoidea is a large and diverse group of medium to large-sized moths that contains over 50,000 species in the world; more than 8000 genera have been described. About three-quarters of the known species are commonly called cutworm moths, or owlet moths, and belong to the family Noctuidae. Other eastern Canadian species are arranged in three families: tiger moths (family Arctiidae) with larvae commonly called woollybears; tussock moths (family Lymantriidae); and prominent moths (family Notodontidae).

The superfamily is characterized by the presence of ears on the thorax just behind the wings. The ear is a complex structure composed of taut membranes, resonator pockets and deflector flaps that allow the moths to detect the sonar calls from feeding bats and to take evasive action.

The fauna of Cape Breton Highlands National Park is discussed below under the individual families.

Family Notodontidae (prominent moths)

The notodontids, or "prominent moths", are medium-sized, stout-bodied moths. The family contains several thousand species but it is primarily tropical and numbers of species decline rapidly northward. About 50 species occur in Canada; the ranges of most only reach southern Canada.

The larvae of most species feed on the leaves of deciduous trees so members of the family are found most commonly in forested areas. The adults, when at rest during the day, resemble dead leaves, bark, or a broken-twig. Those that look like broken-twigs, rest with the wings rolled around the body and stick out in such a way that they can be recognized as moths, and not twigs, only by very close, careful inspection.

The family is relatively well collected in the Park because most species in the Cape Breton area feed on aspen, birch, maple, beech and willow as larvae and so are common in the forests around Ingonish, Pleasant Bay and Cheticamp. Also, most species are readily attracted to lights. Twenty-one species of the estimated 35 possible species were collected. None of the species that were found is considered to be a pest; although, the larvae of species in several genera including *Symmerista* and *Schizura* occasionally occur in large enough numbers to produce localized outbreaks.

Most of the species that occur in the Park are widely distributed in deciduous forest areas in south-eastern Canada. The most common species are *Nadata gibbosa* (J.E. Sm.), *Peridea ferruginea* (Pack.), *P. bastriens* (Wlk.), *Shizura ipomoeae* Dbldy., and *Lochmaeus bilineata* (Pack.). The larvae of most of these species feed on birch and aspen foliage; although, the food plant of *Peridea bastriens* has not been recorded.

One species, *Schizura badia* (Pack.), is usually considered to be quite rare. It was found at the MacKenzie Mountain fire tower. The larva feeds on northern wild raisin (*Viburnum cassinoides*).

Family Arctiidae (tiger moths)

The adults of species that belong to this family are commonly called "tiger moths" since in many species there is a series of alternating yellow and black spots or lines along the body. Many species are strikingly coloured with combinations of white, black, yellow, red or blue markings on the wings and body. The larvae of tiger moths are densely hairy and are commonly called woollybears.

The genera of tiger moths that occur in eastern Canada are arranged in three subfamilies. The subfamily Lithosiinae, in Canada, contains relatively small moths with larvae specialized for feeding on lichens. As many as eight species may occur in Cape Breton Highlands National Park. *Lycomorpha pholus* (Drury), a day-flying species, was regularly observed at Ingonish Beach on the flowers of knapweed and goldenrod. The moths have primarily black wings about 1.5 cm long with the basal third of the wings yellow. The moth is a mimic of distasteful lycid beetles of the genus *Calopteron*. A second lithosiine species, *Clemensia albata* Packard, was collected in the deciduous forests at Lone Shieling. This is a small primarily white species with black speckling on the wings. It is rare in Nova Scotia. The subfamily Ctenuchinae is primarily a tropical group of day flying moths that mimic wasps. Two species occur in eastern Canada and both of these occur in the Park. The most common species, *Ctenucha virginica* (Esper), has black wings about 2 cm long and a bright metallic blue body with patches of orange scales on and behind the head. It occurs commonly in open grassy areas in the Park. A second less conspicuous species, *Cisseps fulvicollis* (Hubner), is smaller (wings about 1.5 cm long) and the wings are narrower. It also flies by day and can be observed in open areas along roadsides as it visits flowers such as goldenrod. The third subfamily in the Park, the Arctiinae, contains the majority of the species. Eight were collected and another fourteen may also occur. Three of the species in this group are much more commonly seen as larvae than as adults. The two species of woollybears that are commonly observed on ground vegetation and roads in late summer and fall are the banded woollybear, *Pyrrharctia isabella* (J.E. Smith), and the saltmarsh caterpillar, *Estigmene acrea* (Drury). The banded woollybear is orange in the middle and black at both ends; it overwinters as a larva and can sometimes be found walking across the snow in late March. The saltmarsh caterpillar is orange; it overwinters as a pupa. The third species commonly observed as a larva is that of the cinnabar moth, *Tyria jacobaeae* (Linnaeus). This species is discussed below.

Cinnabar moth (*Tyria jacobaeae* (Linnaeus))

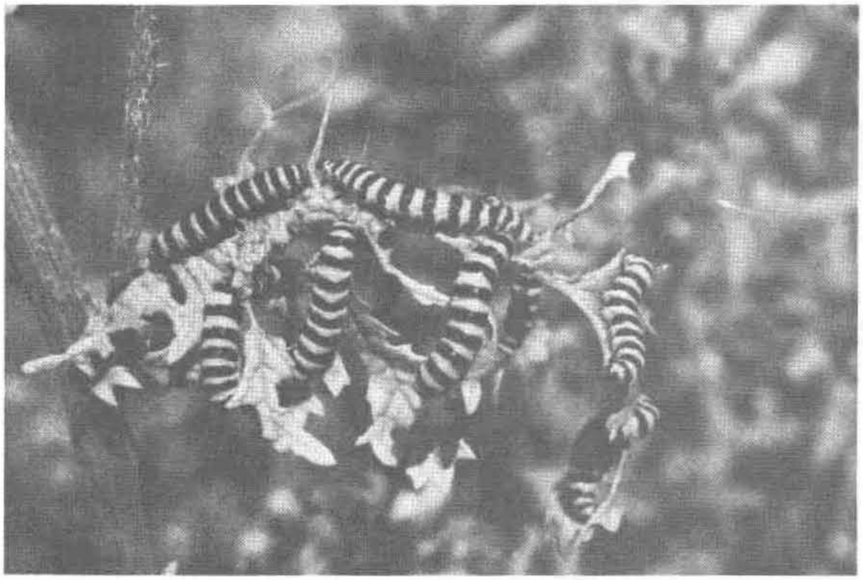


Fig. 12. Caterpillars of cinnabar moth on tansy ragwort

This is probably the most frequently observed species of Lepidoptera in the Park. The cinnabar moth is an Old World arctiid that was introduced into North America in an attempt to control the spread of tansy ragwort (*Senecio jacobaea* L.). Tansy ragwort was first introduced into North America near Pictou, Nova Scotia around 1850 and has since spread through much of the eastern Maritime Provinces. It has also become established in southern Ontario and southwestern British Columbia. The spread of the weed is a serious problem in the northern half of Nova Scotia and in Prince Edward Island because of both cattle poisoning and loss of yield in hay and pasture fields. The cinnabar moth was first introduced in North America on Cape Breton Island in 1961 and has since become well-established in both eastern and western Canada. The larvae occur abundantly throughout all areas of Cape Breton Highlands National Park where tansy ragwort grows. The larvae can be seen in large numbers on the leaves and among the flowers, and are highly visible because of both abundance and also the striking appearance of the larvae with their zebra-like pattern of black and yellow bands along the body. The moth is even more striking in appearance but is less conspicuous because they are present in much smaller numbers. The moth has black forewings, about 2.5 cm long, with red streaks and spots around the margin, and bright red hind wings with black around the margin. The moth flies mostly at night but is conspicuous during the day as it sits on blades of tall grass and is easily flushed into flight. The identity of the caterpillar was a frequent point of discussion among campers at evening interpretive programs during 1984.

Family Lymantriidae (tussock moths)

This is a small family in Canada. Of the twelve species that occur in eastern Canada, only six are expected to occur in the Park and five of these were found. The adults are stout-bodied, broad-winged moths with wing spreads that range from 2.5 cm in smaller species to over 6 cm in female gypsy moths.

The two native genera, *Dasychira* and *Orgyia* are commonly called tussock moths and include two pest species in the Park. These are the rusty tussock moth, *Orgyia antiqua* (Linnaeus), which feeds most commonly on Balsam fir, spruce, and hemlock, and the whitemarked tussock moth, *Orgyia leucostigma* (J.E. Smith), which feeds on a wide variety of trees including Balsam fir, white spruce, white birch, tamarack and maples. Females of species in the genus *Orgyia* are wingless; those of *Dasychira* have larger wings than do the males but are weak fliers.

Four species of lymantriids have been introduced into North America of which two occur in Cape Breton Highlands National Park. The satin moth, *Leucoma salicis* (Linnaeus), is a fairly large (expanse about 45 mm), pure white moth with shiny satin-like wings. It was collected at Pleasant Bay. The larvae feed on species of poplar and willow, particularly ornamental varieties. The gypsy moth, *Lymantria dispar* (Linnaeus), was introduced into North America from Europe in the late 1860's. Its range has gone through several expansion phases since introduction into Massachusetts; it first reached Cape Breton Island in the late 1970's. The widespread defoliation of deciduous forests that occurs annually in northeastern United States has so far been recorded in Canada only in southern Québec; although, local infestations have been reported elsewhere. It remains to be seen whether the harsher climatic conditions in eastern Canada will keep the gypsy moth in check, or if the species will adapt to local conditions and become a major pest in Nova Scotia. In the Park the species was observed only in the Pleasant Bay area.

Family Noctuidae (cutworm moths)

Most adult noctuids are drably-coloured, medium-sized moths that are commonly seen around lights at night. The larvae are rarely seen during the day but can be found by searching vegetation at night.

Cape Breton Highlands National Park may have as many as 300 species of cutworm moths. Slightly more than half this number have actually been found, mostly through the collections made during 1983 and 1984.

The larvae of many noctuid species are serious pests; however, most of these are agricultural pests and are not likely to be a problem in the Park. Pest species recorded in the Park include leaf-feeding species such as the clover looper, *Caenurgina crassiuscula* (Haworth), stem-boring species such as the potato stem borer, *Hydraecia micacea* (Esper), and a wide variety of cutworm and armyworm species. Cutworm larvae feed close to, or under, the ground and snip off plants at ground level. They attack a wide variety of plant species and few are host specific. Common cutworm species in the Park include the red-backed cutworm, *Euxoa ochrogaster* (Guenée), the bronzed cutworm, *Nephelodes minians* (Guenée), the glassy cutworm, *Crymodes devastator* (Brace), and the clover cutworm, *Dicestra trifolii* (Rottenburg). Species that tend to build up in numbers and move in mass are commonly called armyworms; the most common of these, the notorious armyworm itself, *Pseudaletia unipuncta* (Haworth), is common in open areas in the Park. All of the above cutworm and armyworm species, and many additional species as well, were very common in the grassy areas around Ingonish Beach and the Park Operations building.

One species of cutworm in the Park has recently been unintentionally introduced from Europe. *Noctua pronuba* (Linnaeus) was first found in North America in Halifax in 1979 (Niel, 1981). The species has since spread throughout Nova Scotia and become one of the most common cutworms in the Halifax area. It remains to be seen how far the species will spread in Canada and how much of a pest it will become. The species was common in the Pleasant Bay area during July and August of 1984.

A number of noctuid species are migratory and occur in Canada only during the summer but can not survive the winters in Canada. The fall armyworm, *Spodoptera frugiperda* (J.E. Smith), regularly migrates up the eastern seaboard and sometimes reaches Nova Scotia in large numbers. It was common in the Park during July of 1984. Another species that also moves north but only rarely reaches Canda is *Magusa orbifera* (Walker). It has been collected in Canada about a dozen times. One was collected at Black Brook Campground with fall armyworms on 2 August 1984. The only previous records from the Maritimes were collected at Kentville, Nova Scotia, during the 1970's.

Some of the most interesting species in the Park are the very rare ones. *Syngrapha surena* (Grote) occurs in the boreal zone across Canada but is always rare. It has been collected a number of times in Nova Scotia between 1952 and 1984 but all records are from French Mountain in the Park. A similar interesting example is *Exyra rolandiana* Grote, a rarely collected species that lives as a larva in drained pitchers of the pitcher plant. A specimen collected in the bog on North Mountain in 1983, is by coincidence, from the locality in which the species was first recorded for Nova Scotia in 1954. The only record of *Apamea plutonia* (Grote) in Nova Scotia is from the Valley of the Cheticamp River (Ferguson, 1954). Other boreal zone species that were found in the conifer forests above Black Brook Campground but are known from only a few localities in Nova Scotia are *Autographa rubida* Ottolengui, *Mamestra curialis* (Smith), *Anomogyna imperita* (Hubner), and *Xestia oblata* (Morrison).

In general, the cutworm fauna of the Park consists of widely distributed, boreal zone species. The more southerly habitats in the Park, such as the deciduous forests at Lone Shieling, apparently do not contain disjunct populations of southern cutworm species. Similarly, no disjunct populations were found in the highland barrens that normally occur on the mountains of the Gaspé Peninsula, or in Labrador. The apparent absence of both northern and southern disjunctions may be due to the isolated position of Cape Breton Island, and possible to the unstable nature of small pockets of habitats over extended periods of time.

Butterflies

Superfamilies Hesperioidea and Papilionoidea

by R.A. Layberry

Very little has been written about the butterflies of Nova Scotia; Ferguson (1954) lists 68 species recorded for the province. Of these, only 9 are recorded for localities in or near Cape Breton Highlands National Park. The Canadian National Collection has 54 species from Nova Scotia, but only 6 from the Park.

During 1983 - 84, 33 species were collected in or near the Park. Two previously recorded species, *Papilio polyxenes* Fab. and *P. brevicauda* Saunders were not seen, resulting in a total of 35 species.

The butterflies of Cape Breton Highlands National Park are classified in six families.

Family Hesperiidae (Skippers)

Dreamy Dusky Wing *Erynnis icelus* (Scudder and Burgess)

This species has been recorded only 3 times from the Park, at Clyburn Brook, 28.VI.83, Freshwater Lake, 6.VII.83 and on North Mountain, 8.VII.83, only a single specimen at each location.

Arctic Skipper *Carterocephalus palaemon* (Pallas)

This small orange-brown skipper is widespread throughout the Park, though seen more commonly at high elevations. In 1983 it was recorded from 22 June to 14 July.

Least Skipper *Ancyloxypha numitor* (Fabricius)

This tiny skipper is very rare in Nova Scotia, with the only known records in the southern part of the province (Ferguson, 1954). One specimen was taken in the interior of the Park, 10.VII.83 in a tiny, wet clearing in spruce forest on the north side of Round Lake, altitude 1400 ft.

European Skipper *Thymelicus lineola* (Ochsenheimer)

This introduced species is the most abundant skipper in most of eastern Canada, including New Brunswick and Prince Edward Island, and has even spread to Newfoundland. It has not been recorded from the Park, although 4 specimens were seen at South Pond 11.VII.83 and a few near Meat Cove 13.VII.83, both just outside the Park.

Laurentian Skipper *Hesperia comma* (Linnaeus)

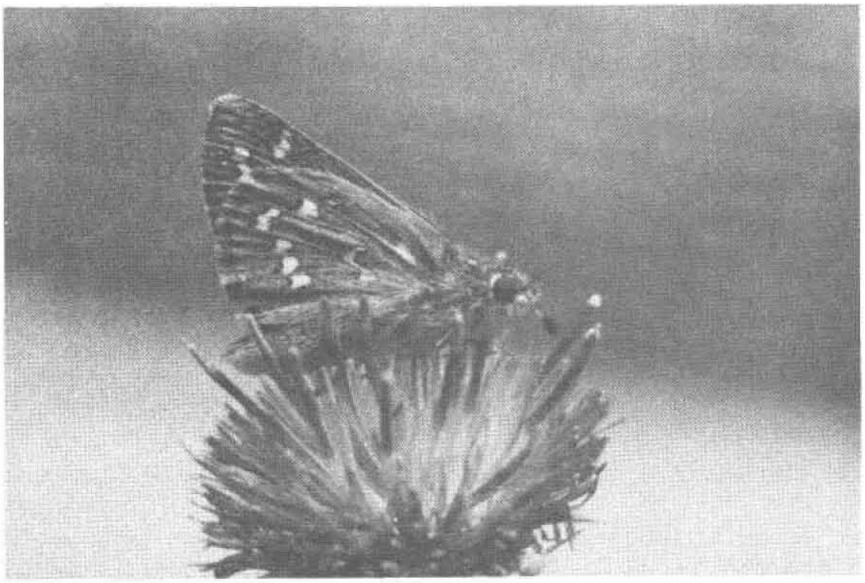


Fig. 13. Laurentian Skipper visiting knapweed, *Centaurea nigra*.

This large skipper, previously recorded only from four southern counties in Nova Scotia, was common at the Visitor Centre at Ingonish Beach, 2.VIII.84 and 5.VIII.84 and at Black Brook Campground, and at Ingonish Dunes on 6.VIII.84.

Peck's Skipper *Polites coras* (Cramer)

This small skipper has been recorded from the Park only twice, at Big Intervale, 26.VI.83 and at Benjie's Lake 14.VII.83.

Tawny Edged Skipper *Polites themistocles* (Latreille)

This species was recorded, in good numbers, from five open, grassy lowland locations, from 23.VI. to 11.VII.83.

Long Dash *Polites mystic* (Edwards)

This species was common at four lowland locations, 23.VI. to 11.VII.83, and single specimens were taken at French Lake, 5.VII.83, North Mountain Bog 8.VII.83 and Benjie's Lake 14.VII.83.

Hobomok Skipper *Poanes hobomok* (Harris)

This woodland species was recorded from six locations 23.VI. to 13.VII.83, much commoner in lowland areas .

Family Papilionidae (Swallowtails)

Black Swallowtail *Papilio polyxenes asterius* Stoll

Ferguson records this species from all over Nova Scotia, including Cape North and Ingonish, and suggests that the species is a recent arrival in the area, the earliest known record being in 1925. Nova Scotia records range from June 17 to August 31.

Short Tailed Swallowtail *Papilio brevicauda bretonensis* McDunnough

This subspecies is confined to the northern half of Cape Breton Island. Ferguson records it from Cheticamp and Cap Rouge, in the Park, and from Terre Noire, and Dingwall, just outside the Park. The CNC has specimens from Baddeck, reared from larvae on *Ligusticum scotica*, from Dingwall, reared from larvae on *Coeloplurum actacifolium*, and from Cape North, all locations just outside the Park.

Tiger Swallowtail *Pterourus glaucus canadensis* (Rothschild and Jordan)

This large, yellow butterfly was recorded at practically every highland and lowland location visited in the Park between 22.VI and 13.VII.83, though never in large numbers.

Family Pieridae (Whites and Sulphurs)

European Cabbage Butterfly *Artogeia rapae* (Linnaeus)

This introduced species was seen in small numbers at four lowland locations in and around the Park, 23.VI. to 13.VII.83.

Common Sulphur *Colias philodice* Godart

Although this species is widely distributed and common all over Nova Scotia, May to October (Ferguson) none were seen during 23 days of intensive collecting in 1983 (22 June to 15 July). In 1984, it was common at Ingonish Beach and on the road to Mary Ann Falls, during late July and early August.

Pink Edged Sulphur *Colias interior* Scudder

This species was found, sometimes in good numbers, in twelve locations throughout the park, 25.VI. to 14.VII.83. It was most common in highland barrens, as would be expected from the larval foodplant, blueberry, but was also seen in the lowlands at Clyburn Brook, Grande Anse, Grand Falaise, Ingonish Beach, and on 2.VIII.84, on the road to Mary Ann Falls, where old, worn *interior* were flying with fresh *philodice*.

Family Lycaenidae (Gossamer-winged Butterflies)

American Copper *Lycaena phaeas americana* Harris

This species was seen at four lowland locations 23.VI. to 11.VII.83, and at McKenzie Mountain 1.VII.83. Second generation specimens were taken at Ingonish Beach, 2 and 5.VIII.84, and at Lone Shieling 14.VIII.83.

Bog Copper *Epidemia epixanthe* (Boisduval & LeConte)

Ferguson records this species as common in cranberry bogs throughout the province as far north as Pleasant Bay. It was taken in North Mountain Bog 6 and 8.VII.83 and was observed at French Lake Bog in July of 1984. It was also taken in small, wet, boggy areas in barrens near Long Lake and Lobster Lake 10.VII.83 and near Benjie's Lake 14.VII.83.

Brown Elfin *Incisalia augustus* (Kirby)

This species has been recorded only once from the Park; it was fairly common in the barrens above Warren Lake in late May 1983.

Spring Azure *Celastrina ladon* (Cramer)

First-generation specimens of this species were seen all over the Park, in highland and lowland areas, between 22.VI. and 30.VI.83. Only one fresh second-generation specimen was seen, at Freshwater Lake on 11.VII.83.

Silvery Blue *Glaucopsyche lygdamus* (Doubleday)

This species was seen at 6 lowland and 2 highland locations, 23.VI. to 13.VII.83. Larvae were found on Vetch *Viccia cracca* at Grande Falaise, 4.VII.83 and on Beach Pea *Lathyrus japonicus*, on the beach at South Pond, 11.VII.83.

Crowberry Blue *Lycaeides idas* (Linnaeus)

Ferguson records this species from the mountains above Pleasant Bay and Cheticamp, both records from specimens in the CNC. In 1983 it was taken at 6 locations in dry, upland barrens habitat in the interior of the Park, 24.VI. to 14.VII. and on low, wind-swept cliff tops, at White Point, and the Still Brook Trail, on 26.VI.83. A female, taken at the McKenzie Fire Tower on 1.VII.83 and confined in a cage with Crowberry, *Empetrum nigrum* laid 14 eggs on the plant.

Family Nymphalidae (Brush-footed Butterflies)

Great Spangled Fritillary *Speyeria cybele* (Fabricius)

In 1983, this species was not seen in the Park, though one specimen was taken near Meat Cove, just North of the Park, on 13.VII.83. In 1984 a few were seen on the road to Mary Ann Falls, 14.VIII.84.

Aphrodite *Speyeria aphrodite* (Fabricius)

The only records of this species from the Park are from the road to Mary Ann Falls, on 2 and 14.VIII.84.

Atlantis Fritillary *Speyeria atlantis* (Edwards)

This was by far the most common fritillary throughout the Park, especially in upland areas. It was seen in nine upland locations 29.VI. to 14.VII.83 and 2 to 14.VIII.84, and also at Ingonish Beach, 2.VIII.84.

Silver Bordered Fritillary *Clossiana selene atrocostalis* (Huard)

This species was very widespread throughout the Park, though less common in the lowlands, 22.VI. to 14.VII.83.

Purple Lesser Fritillary *Clossiana titania grandis* (Barnes and McDunnough)

Ferguson reported that this species was known in Nova Scotia only from a small colony in Cumberland Co. The CNC has specimens from Sunday Lake (9.VIII.70) and between Lake of Islands and Branch Pond (10.VIII.70), both in the interior of the Park. In 1984 a few were taken on the road to Mary Ann Falls, 14.VIII.84.

Pearl Crescent *Phyciodes tharos* (Drury)

This was certainly the most widespread butterfly seen in the Park, almost every day, and in almost every location visited, 22.VI. to 14.VII.83, though never in large numbers.

Green Comma *Polygonia faunus* (Edwards)

This species is widely distributed across Canada in the boreal forest zone. It can be observed in open areas in spruce and fir forests from late April until September. It was collected at Paquette Lake in August.

Morning Cloak *Nymphalis antiopa* (Linnaeus)

This species, scarce throughout Nova Scotia (Ferguson, 1954) has been recorded only once from the Park, a very worn specimen seen at Big Intervale, 26.VI.83.

American Painted Lady *Vanessa virginiensis* (Drury)

This migrant species has been recorded only once from the Park, at Paquette Lake, 13.VIII.83.

Painted Lady *Vanessa cardui* (Linnaeus)

This migrant species was seen at 6 locations in the Park, 23.VI. to 8.VII.83. Larvae were found on thistles near Meat Cove, just outside the Park, 13.VII.83.

Red Admiral *Vanessa atalanta* (Linnaeus)

This migrant species has been recorded twice from the Park, at Paquette Lake, 4.VII.83 and at the Franey Fire Tower, 6.VII.83.

White Admiral *Basilarchia arthemis* (Drury)

This large black and white butterfly was seen regularly in small numbers at upland locations 29.VI. to 14.VII.83.

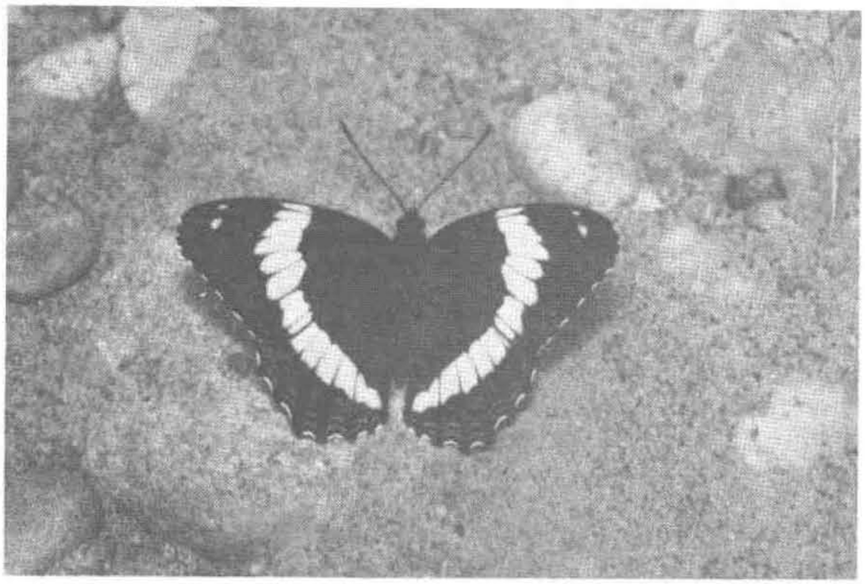


Fig. 14. The white admiral is frequently seen on gravel roads, such as the road to Mary Ann Falls, as they gather on the ground around puddles.

Family Satyridae (Satyrs and Wood Nymphs)

Wood Nymph *Cercyonis pegala nephele* (Kirby)

Although Ferguson reports that this species is common throughout Nova Scotia, the only records from the Park are from Ingonish Beach, where it was common in open grassy areas in 1984.

Jutta Arctic *Oeneis jutta ascerta* Masters & Sorensen

Ferguson reports this species only from Mt. Uniacke, Hants Co., and from French Mountain, in the Park. In 1983, it was taken beside the Cabot Trail on North Mountain on 22.VI., and seen north of Cheticamp Lake, 24.VI., and in French Lake Bog, 27.VI.83.

References

Covell, C.V., Jr. 1984. A Field Guide to the Moths of Eastern North America. The Peterson Field Guide Series No. 30. Houghton Mifflin Company, Boston.

Ferguson, D.C. 1954. The Lepidoptera of Nova Scotia. Proceedings of the Nova Scotian Institute of Science. 23 (Part 3).

Hodges, R.W. 1971. The Moths of America North of Mexico. Fascicle 21: Sphingoidea. London, Curwen Press.

Morris, R.F. 1980. Butterflies and Moths of Newfoundland and Labrador. Agriculture Canada Publication 1691.

Neil, K. 1981. The occurrence of Noctua pronuba (L.) (Noctuidae) in Nova Scotia: a new North American record. Journal of the Lepidopterists' Society 35: 248.

Order Trichoptera

by F. Schmid

The Trichoptera, or caddisflies, are a small order of insects that are related to the Lepidoptera but are considered to be more primitive.

The larvae are always aquatic. A few species live under stones but the majority live in cases which they construct by secreting silk and using it to tie small stones or bits of plant debris into elongate, cylinder-like tubes. Only the head and legs of the larva stick out of the case so they are difficult to see on the bottom of ponds and streams. The adults look like dull-colored moths with long wings and long antennae, and like moths, they frequently come to light at night.

The collections made in the Park represent about 24 species in eight families. This represents about half of the fauna that could be expected to occur. The Trichoptera of Nova Scotia are not very well-known but the neighbouring province of Newfoundland is known to have a fauna of some 120 species in 16 families.

The fauna of Cape Breton Highlands National Park is expected to have a fauna of about 50 or 60 species in 12 families. The species collected to date are all widely distributed species in eastern Canada.

Order Hymenoptera

by L. Masner, J.R. Barron, H.E. Bisdee, L. Dumouchel, H. Goulet, W.R.M. Mason, M.J. Sharkey and C. Yoshimoto

Introduction (by L. Masner)

The Hymenoptera is the largest but relatively least known order of insects in Canada. There are over 6,000 species recorded from Canada and a conservative estimate of species to be discovered exceeds the figure of 10,000 (Masner *et al.* 1979).

The order comprises basically three major groups, *viz.* the sawflies (Symphyta), the parasitic wasps (Parasitica) and the aculeate wasps (Aculeata). The sawflies are represented in Canada by 4 superfamilies, which are divided further in 11 families, and comprise members that are almost exclusively phytophagous, with larvae feeding on plants or boring in wood. The parasitic wasps of the Canadian fauna are represented by 7 superfamilies that are divided into 38 families. Their larvae, as the name implies, live predominantly as parasitoids in other arthropods such as insects, arachnids, etc. The Aculeata is a collective name for true wasps, bees, bumblebees and ants, which are classified in 6 superfamilies and 23 families. The larvae of the aculeate wasps are rarely parasitoids of other arthropods; more often they feed on proteinic or carbohydrate food supplied by parental or worker individuals. The above scheme is not absolutely sharp, with a few groups overlapping, particularly between the Parasitica and the Aculeata.

The members of the order Hymenoptera can be briefly characterized as insects with a complete metamorphosis (eggs, larva, pupa, adult) and adults with two pairs of membranous wings, functional mandibles and in females, with an ovipositor or a stinger. Secondly, some members are wingless, the mouth parts may be transformed into a sucking apparatus and the stinger may be reduced and rudimentary. Sociality developed as a parallel phenomenon, particularly in the aculeate wasps, reaching its maximum complexity in groups such as the ants, social wasps and bees.

The geological origin of the order is traced back to the dawn of the Mesozoic Era. However, their ancestors are believed to have evolved well before the end of the Paleozoic. The insect orders considered to be close to the Hymenoptera are the archaic orders Mecoptera and Neuroptera. Naturally, the oldest fossil specimens are primarily the sawfly-type of Hymenoptera with smaller numbers of primitive Parasitica. The Aculeata did not start their evolution until the end of the Mesozoic and the nectar and pollen collecting bees evolved in association with the development of the flowering plants. The Cretaceous Period, at the end of the Mesozoic, is richly represented in Canada by fossil Hymenoptera preserved in amber found in Alberta and Manitoba (McAlpine and Martin 1969). The present faunal composition of Canada was largely determined by major climatic changes, such as the ice ages, of the Quarternary period.

The three major groups mentioned above represent, through their respective natural histories, both adversaries and helpers to Man. The sawflies, in its broader concept, are primarily pests, comprising defoliators, gall formers, and destructive wood borers. Some species may inflict heavy losses or damage to both herbaceous plants and trees and shrubs. Both forest products and agricultural crops may be attacked. The parasitic wasps, on the other hand, are predominantly "Man's helpers". Their members help to control many pests including many sawfly pests. The parasitic wasps are becoming increasingly important agents in the biological control of pests. Biological control is, in the long run, the only feasible way to control pests without damage to the environment. Only relatively few groups of parasitic wasps are harmful to Man's economy; these are the hyperparasites, gall formers and seed eaters. Aculeate wasps could be considered primarily beneficial to Man. Through parasitism on other insects, or predation on numerous pests, as well as by pollination of many important flowering plants, the aculeate wasps contribute substantially to our economy.

The state of our knowledge of the order Hymenoptera in the Park is regrettably low. Compared with the better known orders, such as the beetles and the butterflies, Hymenoptera never enjoyed the important help received from amateur entomologists. Among the professional entomologists, the Hymenoptera fauna of the Park has been largely ignored, or has received only marginal interest. Yet a closer look at almost any of the numerous habitats in the Park will yield interesting results. The goals, however, may be different, depending on the group involved. The sawflies should be an ideal group to study as the Park encompasses a great variety of species, the taxonomy of which is in relatively good shape. A complex faunal study is feasible pending well-planned, versatile surveys throughout all seasons, preferably over several years.

Plant-insect interactions, behaviour and morphology of the larvae, abundance and density of adults, distribution patterns (e.g. the canopy habitat), etc. could be the highlights. Parasitic wasps, with their overall poorly understood taxonomy, present an entirely different challenge. Basic collecting surveys are a must before taxonomic revisions can be prepared to provide names for further research. The task of thorough, versatile and large-scale surveys cannot be skipped, snubbed or circumvented. To bring at least some comprehensive results, research can be focused on specialized niches such as the parasitic wasps associated with one particular habitat or host (e.g. sea weed debris, sugar maple, and bracket fungi). In general, the territory of the Park could be utilized by professional entomologists as an ideal "laboratory" in the pursuit of progress in both the taxonomy and biology of parasitic wasps.

The study of the aculeate wasps within the Park benefits from the overall good state of the taxonomy of the Nearctic fauna. The studies should concentrate mainly on faunistics (check-lists of species), seasonal and spatial distribution of adults, and habits such as nest construction and provisioning, etc. Special interest should be paid to species reaching the northernmost point of distribution in the Park, their adaptability to northern habitats, life strategies, etc. The social yellowjackets could become an ideal test-group for numerous ecological projects such as Man-wasp competition and coexistence in the Park. The numerous species of bees could be linked to species of wild flowers as pollinators, especially in our northern climatic zone. As a conclusion, relevant to all three groups of Hymenoptera in the Park, a strong appeal for a consciencious field program is hereby issued to overcome the present dismal base of our knowledge.

Suborder Symphyta

by H. Goulet

Symphyta, more commonly known as sawflies and woodwasps, are easily distinguished from other Hymenoptera by the abdomen, which is broadly joined to the thorax, and by the first tergum, which is clearly part of the abdomen rather than the thorax; therefore there is no propodeum, or "wasp-waist", as in other Hymenoptera. The suborder consists of 14 families in the world; 12 are recorded from North America, 11 from Canada and 9 (10 expected) from Cape Breton Highlands National Park. Most families contain few species, except for the Tenthredinidae, which comprises 80% of all Symphyta in North America as well as in the Park. Adults of each family are easily distinguished, but it is generally much harder to distinguish genera and species without the use of a microscope and a good knowledge of characters. I discuss each family; the Tenthredinidae is discussed by subfamilies. Data on distribution in North America are from Smith (1979).

Family Xyelidae (xyelid sawflies)

This family was not recorded from the Park, though 2 genera and 4 species are expected to occur there. In eastern Canada 4 genera and 8 species are known. Habitat suitable for adults was only sampled under adverse conditions. Adults of *Xyela* are usually found on staminate flowers of pines, or on flowers of willows in proximity to their host, the pines. Adults are distinguished by the antennae, in which the third antennal segment is wider and as long as, or longer than, the remaining segments.

Family Pamphiliidae (web-spinning sawflies)

Adults of this family are distinguished by the head, which is very wide anteriorly and exceptionally long behind the ocelli. In the Park, 3 genera and 9 species are recorded, but 4 genera and 20 species are expected to occur; in eastern Canada, 4 genera and 40 species are known. One species of *Pamphilius* in the Park is undescribed; it was first recognized by D. C. Eidt. It occurs in Ontario, New Brunswick and in the Park at Lone Shieling; its host is yellow birch. *Pamphilius middleauffi* Shinohara and Smith is an easily recognized species distinguished by its mostly pale yellow body. The following species are new records for the Maritimes: *P. ochreipes* (Cresson) (host *Viburnum opulus*; 23 specimens mainly from the North Mountain), *P. quebecensis* (Provancher) (5 specimens from Lone Shieling), *P. pallimaculus* (Norton) (host *Rosa*; 3 specimens from North Mountain), *P. middlekauffi* Shinohara and Smith (host *Corylus*; 6 specimens from North Mountain and Lone Shieling), and *P. nigritibialis* Rohwer (17 specimens from numerous areas in the Park).

Family Diprionidae (conifer sawflies)

Adults of this family are distinguished by the antennae, which are more than 15 segmented, and by the shape of middle antennal segments, which are saw- or feather-shaped. In the Park, only *Gilpinia hercyniae* (Hartig) was recorded, but 3 genera and 8 species of the family probably occur; in eastern Canada, 4 genera and 19 species are known. Adults of this family are usually not collected by the techniques commonly used during the survey, unless traps are in close proximity to the host. All species of conifers, except the yews, are potential hosts of Diprionidae.

Family Argidae (argid sawflies)

Adults of this family are recognized by the three-segmented antennae, and the sausage-like third segment. In the Park 1 genus and 5 species are recorded. Two genera of Argidae are expected to occur in the Park; the potential diversity of *Arge*, the genus recorded in the Park, cannot be evaluated as it consists of many unresolved species complexes.

Family Pergidae (pergid sawflies)

Adults of this family are recognized in North America by their minute size (less than 5 mm) and the 6-segmented antennae. In the Park, as well as in eastern Canada, the familly consists of 1 genus and 2 species. Both species are new records for the Maritimes: *Acordulecera dorsalis* Say (host *Quercus*; 21 specimens, mostly from Lone Shieling) and *A. mellina* MacGillivray (10 specimens from Lone Shieling), and are at the northern edge of their range.

Family Cimbicidae (cimbicid sawflies)

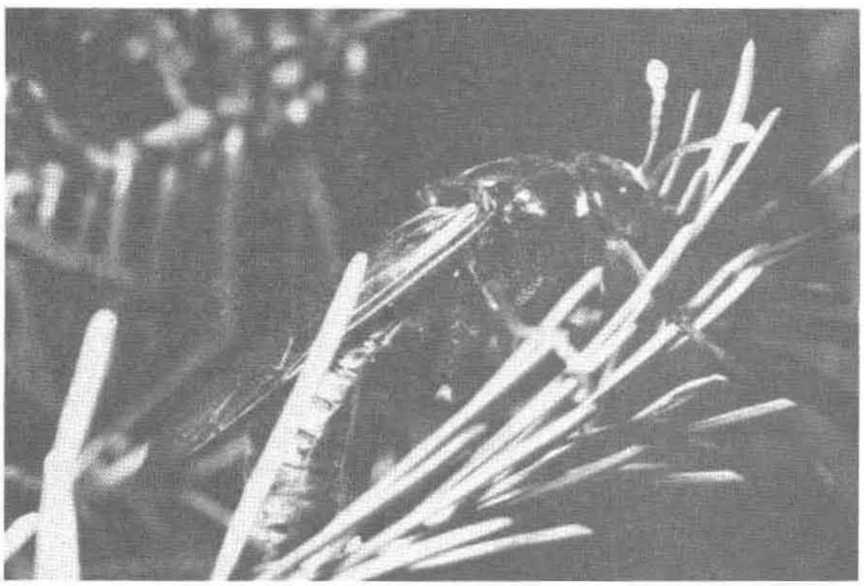


Fig. 15. Female of *Cimbex americana* Leach resting on a fir

Adults are easily distinguished by the club-like antennae. Three genera and 3 species are recorded from the Park; in eastern Canada, 3 genera and 5 species are known. *Cimbex americana* Leach is the largest of the species in the Park. Adults are often collected in June at the highest point of a region (mountain tops or fire towers). *Zaraea americana* Cresson was mainly found at North Mountain where its host, honeysuckle (*Lonicera*) grows in open spruce forests.

Family Tenthredinidae (common sawflies)

Adults of this family are distinguished by the 7 to 10 segmented antennae and the medially narrow pronotum. In the Park 47 genera and 150 species are recorded, but 60 genera and about 250 species are expected to occur. The fauna in the Park is typical of the cold temperate and southern boreal zones. The subfamilies are treated below.

Subfamily Selandriinae. This subfamily includes the species previously included in the Dolerinae. In the Park 5 genera and 20 species are recorded, but 6 genera and 38 species are expected to occur; in eastern Canada, 6 genera and 55 species are known. Most species of this subfamily in the Park, excluding the genus *Dolerus*, have larvae associated with ferns. The diversity of fern feeding sawflies in the Park is exceptional. Not only are all native species of eastern North America recorded in the Park, but in addition *Strongylogaster rufigastra* (Kincaid), a western species, was also discovered. The ferns are diverse and abundant in the Park especially at Lone Shieling, North Mountain, Mackenzie Mountain and along the flood plain of the Cheticamp River. The following *Strongylogaster* species are considered rare elsewhere: *S. macula* (Klug) (known from 2 localities in British Columbia and Ontario; host most probably *Athyrium felix-femina*; 31 specimens from Lone Shieling), *S. polita* Cresson (known from 3 localities in New York, Connecticut and Ontario; host *Pteridium*, an unlikely host in the area of collection; 40 specimens, mostly from North Mountain), *S. remota* Rohwer (known from 2 localities in Pennsylvania and Quebec; 8 specimens from Lone Shieling), and *S. rufigastra* (Kincaid) (recorded from 3 localities in British Columbia; 1 specimen from North Mountain). The above species are new to the Maritimes. *Strongylogaster soriculatipes* Cresson and *S. tacita* (Norton) are new to Nova Scotia. *Aneugmenus flavipes* (Norton) is the most widespread and common species in the Park (host *Pteridium*). Eight species of the genus *Dolerus* were collected, but 24 are expected to occur. Three of the species recorded from the Park are exciting finds: *D. nortoni* Ross (rarely collected species in eastern North America is known from the Park from 1 specimen), *D. maculicollis* (Norton) (a widespread but rarely collected species, is known from more than 130 specimens from bogs in the Park), and *D. hebes* Goulet (a very rarely collected species in eastern North America is known from 2 specimens from Lone Shieling).

Subfamily Blennocampinae. In the Park 9 genera and 11 species are known to occur, but 13 genera and 24 species are expected to occur; in eastern Canada 13 genera and 32 species are known. The following species are new to the Maritimes: *Phymatocera smilacinae* Smith (host *Smilacina*; 5 specimens from Lone Shieling), *P. racemosae* Smith (host *Smilacina*; 1 specimen from Lone Shieling), *Tethida cordigera* (Beauvois) (host *Fraxinus*; 1 specimen from South Harbour), *Paracharactus rudis* (Norton) (2 specimens from Lone

Shieling), *P. niger* (Harrington) host *Carex*; 1 specimen from South Harbour), *Erythraspides carbonarius* (Cresson) (host *Oenothera*; 1 specimen from the Park), *Ardis brunniventris* (Hartig) (host *Rosa*; 1 specimen from North Mountain). The following species are new to the Maritimes: *Monophadnus pallescens* (Gmelin) (2 specimens in the Park), *Monophadnoides geniculatus* (Hartig) (host *Rubus*; common at North Mountain and Mackenzie Mountain), *Stethomostus luteiventris* (Klug) (host *Ranunculus*; 26 specimens almost all from Lone Shieling).

Subfamily Heterarthrinae. In the Park 6 genera and 10 species are recorded, but 8 genera and 17 species are expected to occur; in eastern Canada, 9 genera and 21 species are known. The following species are recorded for the first time in Canada: *Caliroa lobata* MacGillivray (host *Quercus*; 2 specimens from Mackenzie Mountain) and *Endelomyia aethiops* (Fabricius) (3 specimens in the Park). The following species are new to the Maritimes: *Nefusa ambigua* (Norton) (host *Viola*; 17 specimens almost all from Lone Shieling), *Metallus rohweri* MacGillivray (host *Rubus*; 2 specimens from the Park). The following species are new to Nova Scotia: *Metallus capitalis* (Norton) (host *Rubus*; 116 specimens mainly found at Lone Shieling and Mackenzie Mountain), *Caliroa lunata* MacGillivray (host *Rosa*; 35 specimens mainly from Mackenzie Mountain). *Fenusa pusilla* (Lepeletier), the birch leaf miner, is the smallest species of sawfly in the Park; it is exceptionally abundant in areas where there is little or no leaf litter under birches, such as at Pleasant Bay and the flood plain of the Cheticamp River.

Subfamily Allantinae. In the Park, 10 genera and 19 species are recorded, but 10 genera and 39 species are expected to occur; in eastern Canada, 10 genera and 42 species are known. The following species are new to the Maritimes: *Aphilodictium fidum* (host *Rosa*; 1 specimen from the Park), *Dimorphopteryx virginicus* Rohwer (known host *Castanea*, an unlikely host in the Park; 5 specimens were collected, mostly from North Mountain), *Phrontosoma belfragi* (Cresson) (1 specimen from the Park). The following species are new to Nova Scotia: *Dimorphopteryx melanognathus* Rohwer (host *Alnus*; 13 specimens mainly from Mackenzie Mountain), *Empria candidata* (Fallen) (host *Betula*; 1 specimen from the Park). Many of the Park species of this subfamily are brightly colored. Among these, adults of *Empria* are easily recognized by the pairs of white or yellow spots on the abdominal terga, and those of *Macremphytus* by their large size (17 to 20 mm) and tricolored antennae.

Subfamily Nematinae. This is the most diverse sawfly subfamily in the Park; 13 genera and 50 species are recorded, but at least 18 genera are expected to occur. It impossible to estimate the potential diversity of species since all of the large genera in this subfamily are in need of revision. The following comments are based on recently revised genera. *Caulocampus matthewsi* Smith is a new Canadian record (4 specimens from Lone Shieling). The following species are new to the Maritimes: *Croesus latitarsus* Norton (Host *Betula*; 5 specimens from Lone Shieling), *Hemichroa amelanchieridis* (Rohwer) (host *Amelanchier*; 6 specimens from the Park), *Hoplocampa halcyon* (Norton) (host *Amelanchier*; 2 specimens from North Mountain), *Caulocampus acericaulis* (MacGillivray) (host *Acer*; 5 specimens from Lone Shieling; this species flies very early before the leaves are out on the trees). Although most species are not easy to identify, *Croesus latitarsus* is an exception because of the bee-like hind legs which are markedly enlarged and flattened laterally.

Subfamily Tenthredininae. Adults of this subfamily are generally the largest and most colorful members of the family. Five genera and 25 species are recorded from the Park; in eastern Canada, 8 genera are known. *Tenthredo*, the largest genus, is in need of a revision, therefore, I cannot estimate the number of species in the Park. The following species are new records for the Maritimes: *Tenthredo tricolor* (1 specimen from the Park), *T. semirufa* Norton (1 specimen from the Park), *T. mellicoxa* Provancher (3 specimens from the Park), *T. borealis* Kirby (a rare North American species known from the Park from 3 specimens), *Aglaostigma quattuordecimpunctata* (Norton) (an uncommon species, collected abundantly in the Park; 300 specimens were collected, mainly from Lone Shieling), *A. semiluteum* (Norton) (host *Impatiens*; 30 specimens collected, mainly from Lone Shieling), *A. jocusa* (Provancher) (a rarely collected Canadian species; 6 specimens collected, mainly from North Mountain). The following species are new to Nova Scotia: *Tenthredo secunda* MacGillivray (16 specimens from the Park), *T. verticalis* Say (24 specimens collected, mainly from Mackenzie Mountain), *Leucopelmonus annulicornis* (Harrington) (a rarely collected species in Canada; 6 specimens were collected, mainly at North Mountain). The main suprise in the Park is the low diversity of the genus *Macrophya*; only 3 species were recorded. Females of many species of this subfamily are brightly colored and easly recognized: *Tenthredo rurigena* MacGillivray (body black except for a median white line on terga 3 to 9), *T. secunda* (abdominal sterna white, terga 1 to 3 reddish brown and terga 4 to 9 black), *T. borealis* (abdomen black except for segments 5 and 6 which are yellow), *T. verticalis* (colored as *T. borealis*, but terga 2 to 4 with a yellow median line), and *Aglaostigma quattuordecimpunctata* (body almost completely pale yellow).

Family Siricidae (horntails)

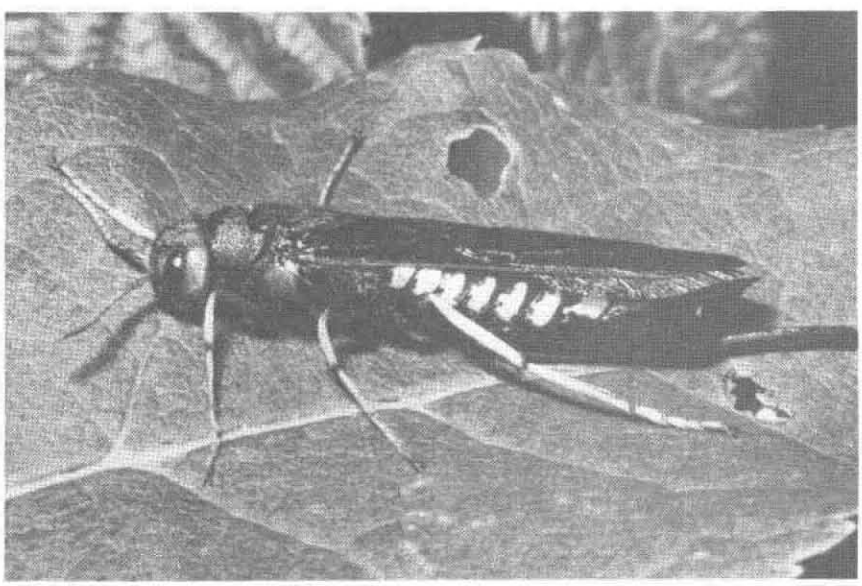


Fig. 16. Female of *Tremex columba* (Linnaeus)
a wood boring sawfly of hardwood trees

Adults are easily recognized by the pronotum, which is clearly transversely folded, and the generally long body size. The Siricidae, or woodwasps, are represented in the Park by 2 genera and 2 species, but 4 genera and 6 or more species are expected to occur; in eastern Canada, 4 genera and 10 species are known. The relatively poor collection is due to the unspecialized collecting methods required to collect these species. These sawflies are not as bulky as *Cimbex americana*, but they are the longest of the Canadian sawflies.

Family Xiphydriidae (wood wasps)

These small woodwasps can easily be recognized by the head, which is clearly separated from the thorax by the long propleura. In the Park 1 genus and 3 species were recorded; in eastern Canada 1 genus and 7 species are known. Larvae of this genus bore in wood of small branches (5 to 10 cm thick) of many species of deciduous trees.

Family Cephidae (stem sawflies)

Adults of this family can be recognized by the markedly narrow constriction in the abdomen between segments 1 and 2. In eastern Canada, members of this family are rarely collected, but 3 genera and 4 species are known. In the Park 1 specimen of *Cephus pigmaeus* (Linnaeus) was found but was later lost.

Suborder Apocrita

by L. Masner

This suborder comprises the two remaining groups of Hymenoptera, namely, the Parasitica and the Aculeata. The members of the suborder differ from those of the Symphyta in having the abdomen distinctly constricted at the junction with the thorax. The vast majority of the larvae feed on proteinic food, or are fed stored pollens and nectars by the adults.

Series Parasitica

by L. Masner

This enormous group of Hymenoptera is not sharply divided from the Aculeata; the primitive groups of the latter series also have larvae that parasitize other insects. Parasitica adults differ from those of the Aculeata in having an ovipositor in the female. There are seven superfamilies of the Parasitica represented in the Canadian fauna, all of them with numerous species in the Park.

Superfamily Ichneumonoidea

Family Ichneumonidae (by J.R. Barron and H.E. Bisdee)

Members of the Ichneumonidae represent one of the largest families of Hymenoptera in terms of numbers of species. They are all parasites, mostly of other insects, and many hosts are economically important pests so they are important in natural and biological control. Twenty-six subfamilies are recognized and the species parasitize a wide range of hosts, mostly members of the order Lepidoptera. The exceptions to these two subfamilies, mostly of which parasites sawflies; one subfamily, which are endoparasites of dipterous larvae, particularly Syrphidae; one subfamily whose members are mainly secondary parasites of other braconids and ichneumonids; two subfamilies whose members are parasites of Mycetophilidae and related groups of Diptera. Adults of Orthocentrinae and Oxytorinae are usually found in moist habitats and are characteristic of wet forests.

The species most commonly found in Cape Breton National Park are predominantly characteristic of boreal forest habitats and most are widely distributed. None is aquatic.

The estimated number of species occuring in the Park, about 1000, is about one-quarter of the fauna of eastern Canada. To date, 345 species have been recorded from the Park.

The most common species collected in the Park were species of small size. Some species were collected in large numbers (e.g. one particular species of *Atractodes* (Phygadeuontinae), and a few common species of Diplazontinae). Other taxa were represented by fewer numbers of individuals. The most common subfamilies in the Park are Ctenopelmatinae, Campopleginae, Phygadeuontinae, Oxytorinae, Orthocentrinae, and to a lesser extent Pimplinae and Diplazontinae. A considerable number of species, found commonly elsewhere, were noticeably absent in the Park. Specimens of one of the largest subfamilies, the Ichneumoninae, were poorly represented. Parasites of the spruce budworm, *Choristoneura fumiferana*, including a few pimplines, *Glypta fumiferana* (Viereck), and *Phaeogenes maculicornis* (Stephens), were scarce, possibly because this pest is presently at the low end of the cycle in the Park, and is known to fluctuate in numbers in relation to its parasites. When host numbers are low, parasite numbers are also low.

Introduced species include *Agrypon flaveolatum* (Gravenhorst), which was introduced into Nova Scotia 1956-1958 to control the winter moth, *Operophtera brumata*, a pest on apple. Another introduced species in the Maritimes, and an important parasite of spruce budworm, is *Phaeogenes maculicornis* (Stephens) from Europe.

A species of *Campothreptus* (subfamily Tryphoninae) was collected from the Park and represents a new species and northward extension of the range of the genus, which had not previously been recorded from Canada.

Species rarely collected include *Scolobates auriculatus* (Fabricius), a parasite of *Arge* (sawflies). This species is holarctic in distribution. *Rhyssa persuasoria* (Linnaeus) is unusual because of its large size, long ovipositor, and habit of parasitizing borers inside conifers; the females literally bore their ovipositors through the bark in the correct place to parasitize the host larva within. Other species, represented by the large subfamily Ophioninae, are large and conspicuous, pale brown in colour, and have very large eyes; they are adapted to a nocturnal way of life, and are attracted in large numbers to lights.

More detailed treatment of selected species of the subfamily Banchinae, parasites of Lepidoptera is given below.

Lissonota acrobasidis (Ashmead).

This species is common in forests. It is transcontinental in the Canadian, Transition, and Upper Austral life zones. The hosts are many species of small Lepidoptera with larvae that are poplar and rose leaf rollers.

Lissonota clypeator varia Cresson

This subspecies occurs from the Atlantic Ocean to the Rocky Mountains in the Canadian and Transition life zones. Adults occur from mid-summer to mid-fall. Reared specimens are from cutworms.

Lissonota tegularis tegularis Cresson

This subspecies occurs mostly in Transition life zone from the Atlantic Ocean westward to Kansas, Texas, and Colorado. Adults occur mostly from late August to early October. It is found in meadows where *Aster* and *Solidago* are abundant.

Lissonota sexcincta recurvariae Cushman

This subspecies is transcontinental in the Canadian life zone. It has been reared from several hosts, especially leaf miners that feed on conifers. Adults occur in summer.

Lissonota nigricornis Provancher

This species is transcontinental in the Canadian and Hudsonian life zones and is often abundant. Adults occur from mid-July to the end of August. The habitat is damp woods.

Lissonota coracina Gmelin

This is a Holarctic species. In North America it is transcontinental in the Canadian and Transition life zones. Adults occur from mid-June until September. The habitat is damp grassy meadows and roadside ditches.

Lissonota exilis Cresson and *Lissonota punctata* Cresson are two common species in eastern Canada but have not yet been recorded from the Park

Isomeris marginata Provancher

This species occurs the deciduous forests of eastern United States and southeastern Canada. Adults occur from early summer to early fall. Its hosts are species of *Trichotaphe* that feed on Compositae. No males have been found and it is presumed to be completely parthenogenic.

Banchus nigroflavus varians Townes

This subspecies occurs in the Transition life zone as far west as the Rocky Mountains. Adults occur from mid-May until late July. *Banchus* species occur in open shrubby country, or open woods. The females fly rather low around low shrubs or over low plants. The hosts are moderately large lepidopterous larvae that feed either on trees or shrubs or on cutworms that live near the soil surface. *Banchus* species form elongate, elliptic, dense blackish cocoons. Adults give off a strong pungent odor when captured.

Family Braconidae (by M.J. Sharkey and W.R.M. Mason)

The Braconidae is the second largest family (in numbers of species) in the order Hymenoptera, and one of the largest families of all Animalia. Braconids are medium sized wasps, usually between 2 and 10 mm long. They are all parasitic on other insects, and most species lay their eggs in the larvae of Lepidoptera, Coleoptera or Diptera.

Although most braconids are parasites of members of the three above orders of insects, they are biologically diverse. Other insect groups attacked by braconids are as follows: Hemiptera, Ichneumonidae (the only example of hyperparasitism in the Braconidae), sawflies, ants, Psocoptera, Chrysopidae and Aphididae. Most hosts are attacked in the larval stage though there are many exceptions. Many braconids of the subfamily Euphorinae attack adult Coleoptera or Hemiptera. Members of the subfamily Cheloninae oviposit in the eggs of their lepidopterous hosts. The eggs remain quiescent inside the host larva until the host has emerged and has nearly completed its growth. At this time the chelonine wasp begins a rapid development and quickly consumes its host from within. The ichneutine braconids have a similar biology but differ primarily in that they attack the eggs of sawflies (Symphyta). No braconids attack the pupal stage of its host though some may emerge from the host puparium or cocoon. As adults, most braconid wasps, as well as many other parasitic Hymenoptera, use nectar as a source of energy.

The majority of braconid wasps are solitary internal parasites, though there are many exceptions. The Macrocentrinae, parasites of lepidopterous larvae, are polyembryonic. Many species of Microgastrinae are gregarious. The female will lay many eggs into a single lepidopterous larva.

A total of about 200 species, half of which are little known parasites of Diptera were collected in Cape Breton Highlands National Park. The 200 species represent less than 10% of the total estimated number of species in Canada and about a quarter the number known from the Ottawa Valley. Notably absent from the Park collections are the many large and conspicuous red and black species that parasitize beetle larvae in dying trees throughout the boreal and deciduous forests.

The most unusual braconid find was an unnamed species of *Sathon*. It was found only once before, in a salt marsh on the shore of the Gaspé Peninsula, but turned up in many areas of the Park. Another notable find was specimens of *Elasmosoma*, a genus known to parasitize ants in Europe but not before reported from North America. Two spruce budworm parasites, *Apanteles fumiferanae* and *Meteorus trachynotus*, were collected but were scarce, probably because of the scarcity of their host at this time.

As expected, and normal in general surveys, most of the species found are widespread and common in the mixed deciduous-coniferous forest zone. Collections from high altitude barrens gave no evidence, in Braconidae, of an Arctic faunal element; not a single arctic species was found.

Superfamily Chalcidoidea

by C.M. Yoshimoto

The superfamily Chalcidoidea, commonly called chalcids or chalcid-flies, is a large group of mostly small parasitic or phytophagous insects within the suborder Apocrita. It is an economically important group of insects, because the larvae of most species eat insects, thus helping to control or suppress insect pest populations on forest and agriculture crops.

The chalcids contain moderately large (20 mm) to minute (0.2 mm) insects, many of which are either black or brilliant metallic green. Most species are parasitic or hyperparasitic on other insects, spiders, mites, or other arthropods. A few are phytophagous; some of them form plant galls (Yoshimoto, 1984).

Most female chalcids parasitize the eggs, larvae, or pupae of other insects and the eggs or juveniles of arachnids. Others feed on plant tissues including stems, leaves, seeds, and flowers; others stimulate the host plant to develop abnormal vegetative growth, called galls. Most species are parasitic and this behavior is distributed throughout the families of Chalcidoidea; a few species feed on plants. The chalcidoids are holometabolous; they develop through egg, larval, pupal, and adult stages. The egg is laid either outside or inside the host with the use of an ovipositor. Either the egg or the newly hatched larva may be deposited.

This superfamily is recognized as being numerically among the largest insect groups and is extremely diverse in form and structure. The group is characterized by the structure of the pronotum and by the very reduced wing venation.

The chalcidoids are composed of between 9 to 21 families, depending on the authority, with an estimated 2000 species in North America, which are included in 466 genera and 18 families (Krombein, 1979). In Canada alone, there are approximately 380 genera and 500 species in 17 families (Yoshimoto, *in* Danks, 1979). The actual number of species may be more than 3 or 4 times the present number known in Canada, based on the number of species collected in Cape Breton Highlands National Park.

Among the large number of chalcidoids collected, there were several genera previously known only from Eurasia. At Lone Sheiling, in the mature deciduous forest, a new species of mymarid, *Eustochus* was collected. At South Harbour, in a mixed deciduous forest of poplar, conifers, and maples, several Holarctic species of Pteromalidae in the genera *Gitognathus* Thomson, *Rhicnocoelia* Graham (Miscogasterinae), and *Chlorocytus* Graham (Pteromalinae) were collected. A striking eulophid, collected from the sandbar area near Cheticamp, was a species of *Microlycus* Thomson.

Numerically, the largest group of chalcidoids collected in the Park were the Eulophidae. Genera collected include *Tetrastichus* Haliday (Tetrastichinae), *Euderus* Haliday (Euderinae), *Elachertus* Spinola (Eulophinae), *Omphale* Haliday, *Chrysonotomyia* Ashmead, *Chrysocharis* Foerster (Entedontinae), *Diglyphus* Walker, *Pnigalio* Schrank and *Sympiesis* Foerster (Eulophinae). The above groups are mostly parasites of Lepidoptera, Diptera, Coleoptera and Hymenoptera (Krombein, 1979).

The second largest family with 34 genera known from the Park is the Pteromalidae. This is the largest family in the Chalcidoidea with the greatest diversity in size, shape and biology. Most species are metallic in colour. Many of the pteromalids in the Park area are primary parasites and hyperparasites of forest dwelling insects. Some of these are *Plutothrix unguttus* (Girault), *Janssoniella caudata* Kerrich, *Gastrancanthus conicus* (Girault), *Dibrachys cavus* (Walker), *Habrocytus phycidis* Ashmead, and *Splangiopelta ciliata* Yoshimoto the latter a parasite of the spruce budworm (Yoshimoto, 1984).

The third largest family is the Encyrtidae. The members of this family are primarily parasites of Coccoidea, though some are parasites of eggs and larvae of other insect groups. A single specimen of a rare and interesting encyrtid, *Mira* sp., was collected in the Park. It is a small, metallic, blue-green species with large, flat, transverse funicular segments and a broad flange-like scape. Encyrtids are represented in the Park by 10 genera . A large number of specimens of *Prionomitus* Mayr, a parasite of nymphs of Psyllidae. Other noteworthy genera of encyrtids collected are *Blastothrix* Mayr, were *Anagyrus* Haliday, *Adelencyrtus* Ashmead, *Cheiloneurus* Westwood, *Copidosoma* Ratzeburg, and *Ericydnus* Walker.

In grassland habitats, several species of *Harmolita* Motschulsky (Eurytomidae) were collected as well as some species of eurytomids which are gall-makers. Several well-known species of coccid parasites, *Aphelinus* Dalman and *Coccophagus* Westwood (Aphelinidae) were also found.

A number of economically important species were collected that are parasites on leaf-mining Lepidoptera larvae. Included in this group are members of the family Eulophidae, *i.e. Pnigalio minio* (Walker), *P. neolongulus* Yoshimoto, *P. uroplatae* (Howard), *P. maculipes* (Crawford) (Yoshimoto, 1983) and *Sympiesis sericeicornis* (Nees). Other common parasite genera collected in the Park were *Pediobious* Walker, *Omphale* Haliday, *Chrysonotomyia* Ashmead, *Tetrastichus* Haliday, *Chrysocharis* Foerster and *Diglyphus* Walker.

One showy group of chalcids collected are the torymids. The females are fairly large, usually metallic in colour have an unusually long, curved ovipositor. These are represented by the genera *Torymus* Dalman, an ectoparasite of gall forming insects; *Monodontomerus* Westwood, parasite of larval and prepupal stages of many insects; and *Megastigmus* Dalman, which feeds on plant seeds. These wasps were collected from the deciduous forests at South Harbour, Lone Shieling, Pleasant Bay, and North and McKenzie Mountains.

In the past, minute, non-metallic species of mymarids, or fairy flies, were frequently not treated in faunal surveys because of their small size and they require specialized collecting techniques to find them (Yoshimoto, 1984). A new collecting method, however, has been developed over the course of many years of research at BRI, Hymenoptera Section. The family Mymaridae is represented in the Park by seven genera; they are all egg parasites of other insects. *Polynema* Haliday and *Gonatocerus* Nees were the predominant genera, while *Anaphes* Haliday and *Anagrus* Haliday were second in terms of numbers of specimens and species.

Among the chalcidoid groups not found during the Park survey were the members of the families Trichogrammatidae, Signiphoridae, Eucharitidae and Tetracampidae. The absence of the above groups may be attributed to the collecting techniques.

Superfamily Cynipoidea

by C.M. Yoshimoto

Wasps of the superfamily Cynipoidea, commonly called cynipids are divided into groups: parasitic wasps and phytophagus, gall-making waps. The superfamily contains seven families that include 84 genera and 500 species in North America (Krombein, 1979). Of this total, 70 genera and 170 species are known from Canada (Yoshimoto, in Danks, 1979).

The cynipoids are moderate (20 mm) to minute (0.5 mm) in size and are non-metallic in color. The pronotum extends to the tegula and is without a median suture dorsad. The fore wing lacks a stigma and the hindwing is without an anal lobe. One of the most important characters for identification of the cynipoids is the presence of an "areola" on the forewing. The gaster is laterally compressed, with most of the tergites visible and the sternum concealed (Weld, 1950).

Members of the family Cynipidae, or the gall-makers and its inquilines, are associated with galls on woody and herbaceous plants. The complex community relationship between plant, gall-maker, inquiline and parasite such as Ormyridae and Torymidae (Chalcidoidea), are generally known from North America. The gall wasps are small insects (1.0 mm to 20 mm) in size. They are wasp-like or ant-like in appearance, mostly black or reddish brown, have a pair of transparent wings with few veins (except in species with asexual wingless females) and a stout, usually oval and compressed abdomen. The larvae are whitish, legless maggots found only inside of completely closed galls. Both the adults and the young are most easily identified by the galls which they produce and in which they develop (Weld, 1950). The gall wasps are highly specialized with marked restrictions in hosts; by far the greater proportion of species occur in oak with relatively few species in other plants such as rose, brambles, and occasionally in other species of plants. The life cycle may be completed in a few weeks, as in the case of many of the spring sexual forms or generations represented by males and females that develop in the soft tissues of buds and leaves, or may require several months to even three or possible four years, as in the agamic or female form or generation, before completing the life cycle. A number of genera with many species were found in the Park. Examples are *Diastrophus*, which occurs in *Potentilla*, *Rosa*, and *Fragraria* in the Lone Sheiling area, *Phanacris* which occurs in *Centaurea* in the Dingwall area, and *Diplolepis* which occurs in *Rosa* in the South Harbour area.

The parasitic Cynipoidea (Figitinae, Aspicerinae and Eucoilinae) are endoparasites, parasitizing the larvae of Diptera; *Ibalia* species are associated with wood wasps (Siricidae), Anacharitidae with lacewings (Order Neuroptera); Charipidae are hyperparasites of aphids parasitized by Aphidiinae (Braconidae) (Weld, 1950).

The family Ibaliidae contains one genus *Ibalia*; it is restricted to the Northern Hemisphere. These cynipoids are relatively large in size, 8-15 mm in the female, with a laterally compressed gaster with tergum 6th longest, and a long ovipositor. A single male specimen of *Ibalia* sp. was collected at Pleasant Bay.

The largest group of parasitic cynipoids is represented by the family Eucoilidae. Numerically, it is the largest in the Parasitic Cynipoidea, and is well represented in the tropics. This group is recognized by the raised, flat plate on top of the scutellum. These are parasite of acalyptrate Diptera.

The members of the genus *Kleidotoma* are well represented from the Park Survey. At Pleasant Bay, along the Red River, about 20 specimens of a short winged, possibly new species of *Kleidotoma*, was collected in pan traps among seaweeds. The winged forms of *Kleidotoma* and *Lonchidia* were collected at Lone Shieling and South Harbour. A number of specimens of *Kleidotoma* were collected on the beaches at Cheticamp. Single specimens of *Episoda* and *Cothonaspis* were collected on North Mountain and at South Harbour respectively. Other interesting cynipoids, such as species of the genera *Tribliographa, Hexacola, Eucoilidea, Pilinothrix* and *Rhoptromeris* were collected on MacKenzie Mountain.

The members of the family Charipidae are widely distributed in Canada. They are internal parasites of primary aphid parasites of the subfamilies Aphidiinae and Aphelinidae. Morphologically, they are very similar to other cynipoid families and, like the other families, are defined primarily by their antenna, wing venation and host associations. The family Charipidae fewer taxa than other cynipoid families. The charipids are less than 2.0 mm long, with the body smooth, shiny and without sculpture; notauli are seldom present, the scutellum is smooth, seldom with distinct foveae at the base and the areola of the forewing is absent. In the Park area, charipids are represented by a single genus *Alloxysta* with a number of species. Specimens were collected at North Mountain and Lone Shieling; they were found in both maple forest and barren areas.

Superfamily Proctotrupoidea s.l.

by L. Masner

This large and highly diverse group of parasitic wasps is well represented in Canada, with estimated number of species nearing 700 (Masner, in Danks, 1979). The actual number of species, however, may be much higher due to the little attention that this group has received in the past. Proctotrupoid wasps inhabit niches that are often overlooked or poorly surveyed by general collectors; therefore, only a fraction of the species dealt with by this report had previously been recorded from Nova Scotia and none was known from Cape Breton Highlands National Park.

Proctotrupoidea is presented here in its rather traditional, broader, more conservative concept (*sensu lato*), i.e. including the superfamily Ceraphronoidea. Altogether there are ten families in this complex in North America, six of which are rich in species both outside as well as in the Park. The four small families not yet recorded in the Park comprise of the Pelecinidae, Vanhorniidae, Roproniidae and Heloridae. The absence may be explained by the relative rarity of some of their members, however, *Pelecinus polyturator* (Drury), a widespread Nearctic species was most probably missed by accident; the females fly in late summer and early fall when most of our surveys had been discontinued.

The Prototrupoidea are composed of groups that are predominantly centered in warmer life zones and tend to decrease in diversity towards the north. A few groups, however, appear to maintain a relatively rich representation even in boreal habitats. The proctotrupoid fauna of the Park reflects these correlations. The number of species is appreciably lower than in other life zones in south-eastern Canada and much lower if compared with the rich deciduous forests around the Great Lakes.

On the generic level, the picture is strikingly similar to that of corresponding habitats in Western and Central Europe. In fact all genera represented in the Park are shared with Europe and none of the genera peculiar to the Nearctic region or penetrating into North America from the South occurs in the Park (Masner 1980a). Several species collected in the 1983-84 seasons also occur in Europe and more are expected to be discovered once the accumulated material is studied in detail. As a rule the genera represented in the Park are the largest Nearctic genera and the species are those with the widest ranges of distribution. No remarkable cases of disjunct distribution involving proctotrupoid wasps in the Park were encountered. On the other hand, several undescribed species known from other life zones in eastern Canada and adjacent United States were recorded in the Park. As a highlight, a few new species were discovered in the Park that are not known so far from anywhere else.

The ecological specialization of the proctotrupoid wasps in the Park occurred in two major life zones. The lowland formation, including the remnants of the Acadian forest (e.g., Lone Shieling) and the adjacent flood plains near Cheticamp and along the more sheltered western slopes of the Park, harboured distinctly more species than the exposed habitats of the highlands, the barrens, and the steep slopes of the eastern shoreline. However, no distinct line can be drawn between these two areas as many species seem to cross the arbitrary border. This is generally true with many groups of Parasitic Hymenoptera, the members of which tend to pay less attention to physical barriers between habitats than many beetles, butterflies, and other insect groups. Consequently, it is rather difficult to categorize the members of the proctotrupiod wasps of the Park into detailed ecological niches or life zone.

Family Proctotrupidae (=Serphidae)

This is a rather small family of proctotrupoid wasps, with 60 species known from Canada and the adjacent United States (Townes & Townes 1981). The members are primary parasitoids (gregarious or solitary) of larvae of various beetles of the families Carabidae, Staphylinidae and Elateridae, or fungus gnats of the Diptera family Mycetophilidae. The adult wasps, mostly males, may be encountered on herbaceous plants; families are usually found on the ground and in the leaf litter. Of the 11 genera that occur in North America only the members of *Cryptoserphus* and *Codrus* (*=Exallonyx*) were recorded in the Park, the former associated with fungus gnats, the latter with staphylinids.

Cryptoserphus flavipes (Provancher) was recorded by Townes and Townes (1981) from Nova Scotia but our material represents the first record from the Park. This is a Holarctic species, widespread in both North America and Europe. Individuals were trapped during June-July in both lowland as well as highland situations.

Cryptoserphus dilatus Townes and Townes, another Holarctic species, was recorded in North America from Newfoundland to Alaska (Townes & Townes, 1981). Our material is the first record for both Nova Scotia and the Park. We collected more individuals of this species than of *flavipes*, again with no particular preference for altitude or habitat; they were collected during June and July.

Codrus is a taxonomically difficult genus with some species needing further detailed study. Four species could be distinguished in our material; they were collected from early May until late July.

Family Diapriidae

This a large and diverse family with 36 genera and several hundred species known or expected to occur in Canada. The diapriids are generally better represented in northern part of the Nearctic region than other families such as the scelionids. As a result, representatives of 26 genera were recorded from the Park; this is a substantial portion of the North American fauna. The subfamily Belytinae, in particular, is strongly represented in the Park with 14 genera known out of 16 known from North America. The subfamily Diapriinae is also well represented with 10 out of 18 Nearctic genera known to occur in the Park. The small subfamilies Ismarinae and Ambositrinae are represented by 1 genus each, as they are in the rest of North America. Unfortunately, the taxonomy of these subfamilies at the species level is still in its infancy in North America, with only a few genera revised. In general, the diapriid fauna of the Park shows strong relationships with the Palearctic fauna of Western Europe; this is particularly evident in the subfamily Belytinae where at least some species appear to be Holarctic. From an ecological point of view, most diapriids appear to be opportunistic in their choice of habitat but generally shaded, moist situations are preferred throughout the Park. Diapriids are generally parasitoids of the Diptera, attacking a wide range of dipterous hosts; a few attack non-Dipterous hosts. The species found in the Park survey are outlined below under the respective subfamilies.

Subfamily Belytinae. The members of this large group are all presumed to attack fungus gnat larvae (Mycetophilidae) although only a few host records are available. The adult wasps may be observed on or inside mushrooms, but are more frequently swept from herbaceous plants in wet shaded habitats. The peak of abundance is from mid-summer to late fall; although quite a few species occur also in early spring. Judging from the high number of both individuals and species, the members of Belytinae play an important role in the Park ecosystem. They can be rivaled numerically only by the members of the family Platygastridae, another large group of proctotrupoid wasps in the Park.

The most widespread species in the Park was *Polypeza pergandei* Ashmead; it was recorded from both lowland Acadian forest and highland barrens. This is the first Canadian as well as Nova Scotia record of the species. It is possible that this species will be shown to be identical to a European species after taxonomic studies have been completed.

Belyta longicollis Fouts (Pleasant Bay, July 1983) is a remarkable species not previously recorded from Canada. The following genera of the Belytinae were represented in the Park by one or more species: *Pantoclis, Belyta, Acropiesta, Opazon, Aclista, Miota, Oxylabis, Acanosema, Macrohynnis, Zygota*. The state of taxonomic knowledge of these genera in North America does not permit identification of species. Specimens that represent two genera new to science were collected in the Park, one of them not known to us from outside the Park.

Subfamily Ismarinae. This is a small, monotypic subfamily with 11 species known in North America (Masner 1976). The members are hyperparasitic on larvae of dryinid wasps that attack leafhoppers and fulgoroids (Homoptera). Two species were collected in the Park, *Ismarus rugulosus* Foerster and *I. halidayi* Foerster, both first records for the Park and Nova Scotia.

Subfamily Ambositrinae. This is a rather large group of exotic diapriids with only one species *Propsilomma columbianum* (Ashmead), known in North America (Masner 1964). A single specimen was caught in a pan trap on barrens near Paquette Lake; this constitutes the first record for the Park and for Nova Scotia. The members are presumed to attack fungus gnat larvae.

Subfamily Diapriinae. The members of this large group are primary parasitoids of Diptera attacking such groups as the Ceratopogonidae, Tabanidae, Stratiomyidae, Syrphidae, Anthomyidae, Muscidae and Tachinidae. Some species are confined to the tidal zone where they attack kelp-flies (Coelopidae) in the seaweeds. A few host records also include beetles but these species were not encountered in the Park. Diapriids are most abundant on herbaceous plants and ferns in shady moist places. The adult wasps occurs in the Park throughout the entire season with the peak in abundance in mid-summer.

The outstanding records of diapriids in the Park include the following species: *Spilomicrus formosus* Jansson, a Holarctic species which is a new record for the Park and for Nova Scotia; it was reared in Europe from sepsid flies; *Spilomicrus bifoveatus* Kieffer, a widespread Nearctic species was recorded for the first time from the Park and for Nova Scotia. Three undescribed species of *Spilomicrus*, known to us from outside the Park, were also captured. *Trichopria pezomachoides* Ashmead, a species with remarkable wing polymorphy in both sexes, was recorded for the first time from the Park and Canada as well. *Trichopria* sp. was encountered in high numbers in beds of fucus algae on the beaches near Red River. Curiously enough, another intertidal diapriid wasp, *Platymischus dilatatus* Westwood, recorded for the first time in North America from beaches in New Brunswick (CNC), was missing from the Park. Similarly, as in the Belytinae, the taxonomy at the species level is not advanced in many genera of the Diapriinae. The following genera were represented by a number of species each: *Basalys, Paramesius, Trichopria, Entomacis, Coptera, Psilus, Aneurhynchus, Monelata, Idiotypa*. Of particular interest is one undescribed species of *Trichopria* collected on plains near Cheticamp, the females of which show a peculiar sensory pit on the ventral side of the apical segment of the antennal clava. Closer examination of this structure is under way with the help of scanning electron microscopy.

Family Scelionidae

This is a large family of proctotrupoid wasps with over 50 genera known to occur in North America (Masner 1980a) and with an estimated 300 species in Canada (Masner in Danks, 1979). Generally a southern group, the Scelionidae tend to decrease dramatically in both species diversity and frequency of individuals in the more northern zones of Canada. As a result of this, representives of only 5 genera were encountered in the Park. Of these five genera, only two genera (*Telenomus, Trimorus*) were better represented, i.e., with more than 1-2 species. Scelionid wasps are primary parasitoids in eggs of various insects and spiders. The major orders of insects attacked are the Orthoptera, Hemiptera and Lepidoptera. With many of their current hosts not represented in the Park, the fauna of scelionids is severely limited. The biogeographic ties of these genera are with the Palearctic fauna, with one species shared, namely *Tiphodytes gerriphagus* (Marchal).

Subfamily Scelioninae. Three genera were represented *viz. Scelio, Idris* and *Tiphodytes*. The only specimen of *Scelio* (from the barrens near Paquette Lake) may represent an undescribed species. Members of this genus are parasitoids of grasshopper eggs (e.g., genus *Melanoplus*). The single specimen of *Idris* (from North Mountain) belongs to an undescribed species known to us from other areas outside the Park. Members of *Idris* attack the eggs of various spiders. The genus *Tiphodytes* is represented in the Park by two species, *viz. T. gerriphagus* and *Tiphodytes* n.sp. The latter species, with a series of 23 individuals, is one of the highlights of the 1984 collecting season in the Park. The members of *Tiphodytes* attack the eggs of water striders (Gerridae) and the genus was only represented in North America by a single species, *T. gerriphagus* (Masner 1972). The discovery of a distinct new species reaffirms the previously held view that *T. gerriphagus* is a native Holarctic species, not introduced by man. Both species were collected in pan traps near creeks (Pleasant Bay, Cheticamp plains). It is interesting to note that the new species is not known to us from outside the Park inspite of intensive trapping in suitable habitat in other areas of Canada and the United States. However, it may have been overlooked because of its spring peak of occurrence (late May); most of our trapping elsewhere has been done from mid- to late summer. The formal description of this new species will be published elsewhere.

Subfamily Teleasinae. The only genus, *Trimorus*, was represented by several species in both the lowland and the highland areas of the Park. Worth mentioning is a long series of individuals belonging to an undescribed species of the *ninus*-group (Masner 1962); it is known to us from various localities in eastern Canada and the adjacent United States. The individuals were caught in pan traps near creeks at both Pleasant Bay and Cheticamp. All members of the Teleasinae are believed to attack the eggs of ground beetles (Carabidae).

Subfamily Telenominae. Two genera are represented, *viz. Trissolcus* and *Telenomus*. A long series of *Trissolcus thyantae* Ashmead was collected near Pleasant Bay (July 1983); this is the first record for Nova Scotia and the Park. The wasp attacks eggs of various members of the Pentatomidae. The genus *Telenomus*, the members of which usually attack eggs of Lepidoptera, less frequently of Hempitera, is represented by several species. Among the more interesting records is *Telenomus longicornis* Ashmead. A series of individuals, males and females, were caught in pan traps along creeks near Pleasant Bay and Cheticamp. This species is associated with aquatic habitats and so presumably is its unknown host. The record is first for the Park, Nova Scotia and Canada as well.

Family Platygastridae

This is a large family of proctotrupoid wasps with 20 genera recognized in North America (Muesebeck in Krombein 1979) and with estimated 300 species in Canada (Masner in Danks 1979). The platygastrids are well represented in both tropical and temperate zones, extending in Canada into the low arctic. Consequently, their representation in the Park, with 15 genera recorded, is second only to the Diapriidae. The number of species and the frequency of individuals is very high in all principal habitats surveyed. The faunal relationships are Holarctic, with several species shared with Europe. The members of this family are primary parasitoids of various insects. The more primitive members are true egg parasitoids, attacking weevils, or ovipositing in young stages of mealybugs (Pseudococcidae) or whiteflies (Aleyrodidae). The more advanced members are parasitoids of gall midges, attacking the egg or young larva of the host but developing only later when the midge almost reaches maturity. Some species of the latter group are noted for polyembryonic development, with multiple individuals resulting from a single fertilized egg. Formerly, the family was divided into two subfamilies the nature of which is now known to be artificial. The following species and genera are considered highlights of our survey.

Acerotella aceris Masner and *Metaclisis acericola* Masner were collected in series during May and June, predominantly in lower areas of the Park. The two species are believed to be associated with sugar maple and its gall midge pests respectively (Masner 1980b, 1981). Naturally, the maple forest in Lone Sheiling produced most of the individuals. These new records for the Park and Nova Scotia are a significant eastward extension in the known range of the two species.

Iphitrachelus lar Walker is a Holarctic species extending southward to Central and South America. The record from the barrens near Paquette Lake is a new record for the Park, Nova Scotia and Canada east of Ontario (Masner 1976a). *Fidiobia* n.sp., a shortwinged undescribed species, was collected along the Skyline Trail in July. *Trichacis virginiensis* Ashmead, collected in Lone Shieling, is a new record for the Park and for Nova Scotia (Masner 1983). *Metanopedias lasiopterae* (Kieffer), caught in pan traps on barrens near Paquette Lake, is the first Nearctic record; the species was previously known from Britain, Sweden, Italy and Germany (Huggert 1980). *Isocybus canadensis* (Provancher), the largest Nearctic platygastrid, was collected in series along the Anse River on *Carex* sp. in May and June. It is the first record for the Park and for Nova Scotia. The large genus *Platygaster* is represented by many species in the Park, most of them peaking in spring. Quite noteworthy is a record of a single specimen of *Platygaster beneficiens* MacGown from Lone Shieling. This species, new to the Park and Nova Scotia, is associated with gall midges injurious to white spruce cones (MacGown 1979). The genera *Amblyaspis, Leptacis* and *Synopeas* were represented by several species each, whereas *Allotropa, Euxestonotus, Anopedias* and *Inostemma* by only one or two species each.

Families Ceraphronidae and Megaspilidae

These two smaller families of parasitic wasps were recently shown to form an independent superfamily of Parasitic Hymenoptera (Masner and Dessart 1967). There are only a few genera in North America with an estimated 200 species in Canada; almost all of them are poorly known taxonomically. The members of the Megaspilidae are partly primary parasitoids of various Diptera (e.g., Syrphidae) and partly secondary parasites of the Aphidiidae (Ichneumonoidea). Members of the genus *Conostigmus* (2 species) belong to the former, whereas *Dendrocerus* sp. belongs to the latter group. The members of the Ceraphronidae are either primary parasitoids of gall midges (e.g., *Aphanogmus* sp. in the Park) or secondary parasites of other parasitic wasps such as the Braconidae.

Series Aculeata

by L. Masner

This large group of Hymenoptera comprises wasps with a functional stinger in the female sex (or the worker caste), although some primitive members still use the stinger as an ovipositor. There are 5 or 6 superfamilies (depending on the system followed) of Aculeata in Canada, all of them with representatives in the Park.

Superfamilies Chrysidoidea and Scolioidea

by L. Masner

These two rather small superfamilies represent the transition from the Parasitica to the Aculeata. The females have poison glands joined with the ovipositor-stinger and use it to paralyze their prey before depositing an egg on it. There are 12 families in these groups with an estimated 100 species expected to live in the Park. The more numerous members of the Bethylidae and the Dryinidae will undoubtedly escape visitor's attention, largely because of their small size, which does not exceed 3 mm on average. A more careful naturalist, however, might spot an odd looking leafhopper (Homoptera) carrying a large bag on one side of the abdomen. Inside the bag is a larva of a dryinid wasp that will eventually kill the host. The apterous females of the velvet-ant family of wasps (Mutilidae) will nervously cross the visitor's path in search of nests of solitary bees or bumblebees. If skilfully caught by a forceps they will produce a distinct sound that in Germany earned them the name "singing ants". They will also display a stinger that can deliver a painful sting. The males of velvet-ants are winged and often visit flowers of wild carrots to feed on nectar. The females of the families Tiphiidae and Scoliidae spend most of their time on the ground searching for grubs of June beetles. On a sunny day, a visitor may admire the emerald green gold wasps of the family Chrysididae on the walls of log cabins in the Park. The females of these "cuckoo-wasps" search the nests of numerous solitary wasps and bees in which to lay their eggs. Most species of these wasps are at, or near, the northern limits their range in the Park. The center of origin and evolution of these groups is in the tropics.

Superfamily Formicoidea

by L. Masner

The ants are another typically tropical group that is represented only marginally in Canada. Classified now in a single family, the Formicidae has 139 species recorded from Canada. We do not have a detailed list of species of ants in the Park but we estimate that about 30 species occur there. Some species form conspicuous nests, with large colonies and numerous individuals. However, more species live cryptically, in small concealed colonies, e.g. in hollow twigs or deep in the soil, etc. As a whole, ants are beneficial insects, controlling number of potential pests, especially in the forest ecosystems. Some species, however, may become pests if competing with Man for crops or by destroying wooden buildings. Ants are remarkable for their social organization, division of labour and care of the progeny. The visitors in the Park should spend time watching their activities on a sunny summer day, while keeping a safe distance from their powerful mandibles. The more primitive ants retain a functional stinger in female worker castes. The more advanced ants (including carpenter ants) have the stinger reduced to a rudiment or missing entirely. To offset the loss of this weapon, they have developed a skilled use of formic acid, which is exuded or spit when the ant is attacked. Neverthelsss, numerous organisms, including birds, frogs, small rodents and even large mammals such as bears, like to feed on ants and their larvae. The life of an ant colony is highlighted once a year by a nuptial flight of the winged sexuals (females and males). Almost coinciding into one day (usually after a heavy rain in late summer) the colonies in the Park will produce clouds of winged individuals. During the short melee high above the nest, the females mate with several males, landing shortly afterward and loosing their wings. This is an adaptation for the future queen to establish a new colony after successful hibernation. This pattern is basically similar for members of all major genera of ants in the Park, such as *Formica, Camponotus, Lasius, Myrmica, Stenamma, Leptothorax*, etc.

Superfamily Vespoidea

by L. Masner and L. Dumouchel

In its rather traditional interpretation, this superfamily contains only two families, *viz.* the Vespidae and the Pompilidae. The former group is better known as yellowjackets, or hornets, while the latter group is called the spider wasps. The two groups, however, differ considerably in both biology and morphology and will be dealt with separately.

Family Pompilidae (by L. Masner)

The more primitive spider wasps are non-social predators of spiders. With some 100 species known to occur in Canada, the Park may harbour about one third of the species; the group is much better represented in the southern parts of the North American continent, particularly in arid areas. As the common name implies, the life of the wasps of this family revolves around spiders. Armed with strong stinger, powerful mandibles and swift, long legs, the spider wasps rarely miss their prey. More often hopping and leaping than flying, they relentlessly conduct their mercurial search for spiders on hot summer days. After a short skirmish, the spider prey is paralyzed and dragged into a burrow in the ground. An egg is laid on the still living but paralyzed spider. Some spider wasps are cleptoparasites on members of their own family. Instead of hunting their own prey, they steal spiders from the burrows of other species. Visitors to the Park should exercise maximum caution not to touch the females of any species of spider wasps. The venom intended for spiders will deliver a painful lesson not to be forgotten.

Family Vespidae (by L. Dumouchel and L. Masner)

The family Vespidae in Canada comprises the solitary species of the subfamily Eumeninae and the social species of the subfamilies Polistinae and Vespinae. All members of vespids are easily recognized by a deep kidney-like inner margin of eyes, as well as by the longitudinally folded wings when resting. About 100 species are recorded from Canada, mostly the solitary species of the subfamily Eumeninae.

Subfamily Eumeninae. The number of species of the solitary Eumeninae in the Park is estimated at 20 to 30 but no names can be provided because of the poor state of the taxonomy of the group. The solitary-living members of the Eumeninae (Odynerinae) are highly beneficial predators of various pests. The females provision their nests with caterpillars or beetles that defoliate various trees and bushes. Eumenids nest in old logs, twigs, or construct nests of mud, suspended from plants.

The subfamily Polistinae is represented by a single widespread species, *Polistes fuscatus* F. Polistine wasps are social and build open nests suspended from a stalk, usually under overhanging objects such as rocks, branches and leaves.

The subfamily Vespinae are social wasps that use their well-developed sting primarily for defense. Their nests are made of a papery material and consist of numerous rounded combs attached one over another and surrounded by an outer multi-layered covering. Vespines of the genus *Vespa* commonly known as hornets, are represented in North America by only one species, *V. cabro* L. and do not occur in Cape Breton Highlands National Park. We discuss only about groups that occur in the Park, namely members of the genera *Dolichovespula* Rohwer and *Vespula* Thomson, often referred to as "yellowjackets".

Among the five species of *Dolichovespula* that can be found in the Cape Breton Highlands, only three species were actually collected.

Dolichovespula arenaria (Fab.). Also known as the "aerial yellowjackets", this wasp is very common and has a transcontinental distribution that extends from north-central Alaska to Arizona and New Mexico in the west and from north-central Quebec and Labrador to Tennessee in the east. Its nests are often found close to the ground in bushes and grass, sometimes beneath rocks or in the ground and also under house and garage roofs. The workers of the colony do not scavenge for proteinic food but may be attracted to sugar sources during early fall; at this time they can be annoying to picnicers. Their encounters with man also increase when nests are built in man-made structures. Isolated workers can sometimes be seen buzzing around people's head and following them for quite a distance through the woods. Thus, although *D. arenaria* is not a serious pest of man, it can be quite annoying at times and some form of control may be required.

Dolichovespula maculata (L.). This widely distributed black and white yellowjacket is also called "baldfaced hornet". Its range extends from the boreal and temperate zones of Canada to southern United States. It is a large species (15 mm. or more in length) easily recognized by the entirely black surface of the 1^{st} three abdominal tergites. The nests of *D. maculata* are quite large and often found suspended from limbs fairly high in trees and under the eaves and roofs of houses. *Dolichovespula maculata* is generally not a nuisance for man since it is non-aggressive and rarely scavenges for protein; its nests are usually high enough to be out of reach.

Dolichovespula norvegicoides (Sladen). Very little is known about the biology and behavior of this species. Its distribution is similar to that of *D. arenaria* and its nests are aerial but close to the ground and quite small. There is no recorded evidence of interaction of this wasp with man.

Three of the five (possibly seven) species of *Vespula* occuring in Cape Breton Highlands National Park were recorded. *Vespula acadica* (Sladen) and *V. consobrina* (Saussure) are members of the *V. rufa* species group, which includes six species having similar morphological and biological features. Their occipital carina (ridge at the back of the head) is prominent in dorsal view and ends well above the base of the mandibles. The 1^{st} abdominal tergite is narrowed at the base and slightly depressed behind the anterior margin. They forage only for live prey and rarely bother man. The third species, *Vespula vulgaris* (Linnaeus) belongs to the *V. vulgaris* group whose members have a well developed occipital carina that extends to the base of the mandibles. Their 1^{st} abdominal tergite is not narrowed at its base and is not depressed. The wasps are scavengers and are frequently a nuisance to man.

Vespula acadica (Sladen). This "forest yellowjacket" has a transcontinental distribution in the Canadian zone that extends from Alaska to New Mexico and California in the west and from Maine to Minnesota in the east. Its encounters with man are rather infrequent, since the nests, which are either aerial, subterranean or in decaying logs, are located primarily in forested areas. When disturbed, however, the workers can be quite aggressive and sting repeatedly.

Vespula consobrina (Saussure). This black and white yellowjacket, known as the "black jacket", occurs in forested areas throughout the boreal regions of Canada and northern United States as far south as California, Arizona and

New Mexico in the west and Georgia in the east. The nests, usually subterranean, are often built in rodent burrows but may also be in shrubs, logs or rock cavities just above the ground and sometimes in the walls of houses. As with *V. acadica*, there are few contacts between this species and man but if aroused, the workers will sting repeatedly.

Vespula vulgaris (Linnaeus). This species also named "common yellowjacket" is widely distributed throughout Canada, Alaska, United States south to California, New Mexico, Arizona, South Dakota, Iowa, Indiana, Illinois, Ohio, and North Carolina. Most nests are subterranean or built in rotten logs, in stumps and sometimes in the walls of houses. *V. vulgaris* workers exhibit both foraging and scavenging habits. Being attracted to almost all protein and sugar sources, theese yellowjacket are frequently quite annoying to man in recreational areas such as provincial and national Parks, in urban and suburban areas such as playgrounds, athletic facilities and zoos, and in forested areas where logging operations take place, etc.

Many yellowjackets in addition to these mentioned above have acquired a reputation of being injurious to man but we should not forget that some are quite beneficial by preying on and controlling a variety of pest insects. More complete studies on the biology and behaviour of the yellowjackets should be encouraged to further our understanding of these fascinating, colourful insects.

Superfamily Sphecoidea

by L. Masner

This is a large and highly diverse group of aculeate Hymenoptera. There are 1230 species recorded from North America of which 225 reach Canada; Finnamore (1982) reports 158 species from Quebec. No faunal list is available for the Park but a reasonable estimate will bring the fauna to about 100 species, represented in seven subfamilies of the family Sphecidae.

Sphecid wasps are related to bees and many experts join both groups into one. Unlike bees, the sphecids are usually only sparsely hairy or devoid of hair. Their larvae are carnivorous, feeding on prey provisioned in specialized nests by the females. The prey consists of a variety of insects or spiders, but each group tends to stick to one particular type of prey. From this point of view, almost all species are important agents in natural control of potential pests. The prey is paralyzed by a poison injected by a stinger, and the prey are stacked in specialized nests where the sphecid larva will develop. The adult wasps will feed on nectar or honeydew and occasionally also on body fluids of the prey. Sphecids are renowned nest builders. Nest structure is very diverse, ranging from temporary single-celled solitary nests, to multicellular nests in a permanent nesting aggregation. True sociality has never been achieved, at least among species in the temperate zone. Sandy cliffs of an abandoned sand pit, sun-exposed dusty trail or an old log are the favourite areas where various sphecid wasps may be encountered. The patient observer will be rewarded by the skilled performance of a sphecid female first digging and later provisioning its nest. Slender females of the genus *Ammophila* will carry paralyzed cutworm larvae; the more robust females of genus *Sphex* will catch green tettigoniid grasshoppers; the scary-looking mud dauber (*Sceliphron caementarium* Dr.) will drag a big spider to its mud castle attached to a nearby rock. The species of *Philanthus* will hunt both solitary bear and honey bees, an exception to the general beneficial role for sphecid wasps. The generally smaller members of the genera *Stigmus* and *Pemphredon* will search plant foliage for aphids that they will pack in numbers into their nests in hollow twigs. Some cleptoparasites may also be found among the sphecids. Instead of doing their own hunting, they prefer to either steal the prey from other species or to usurp their nests.

Superfamily Apoidea

by H. Goulet and L. Masner

This is the largest group of all Aculeata, with nearly 3700 species described or known from North America; of these, 746 species have so far been recorded from Canada. Only bees of the family Apidae were surveyed in the Park but an estimated 300 species of Apoidea may be expected to live there. Bees are generally believed to have evolved from sphecid wasps by way of specialization in body pilosity. In fact, some primitive bees of the family Colletidae, with sparse body pilosity, may look like sphecid wasps by non-experts. The bees also differ from the sphecid wasps in that they supply their larvae nectar and pollen rather than prey. Also, it is the bees where sociality reached its maximum in both complexity and versatility. However, unlike the popular belief the vast majority of bee species are solitary (about 76%), some are parasitic (12%) and a few (12%) are social or subsocial. The majority of species in the Park will belong to relatively few large genera, such as *Andrena, Halictus, Megachile, Anthophora* and *Bombus*. These genera together with about two dozen smaller genera are arranged into 8 families.

The role of bees as pollinators has never been adequately recognized. And yet, the vast majority of wild flowering plants depend solely or predominantly on bee activity, as do some 50 fruit and seed crops cultivated by Man.

The bees have extended and perfected the nest building skills of their sphecoid ancestors. The nests of many solitary bees are truly ingenious in both the selection of place and the choice of material. The subterranean nests of some halictid bees are complicated labyrinths with specialized chambers. Unlike the sphecids, the bees manage to penetrate harsher climatic zones, such as high mountains and the arctic tundra. It is, therefore, not too surprising that the bees in the Park overshadow the sphecid wasps in both number of species and individuals. The visitor may distinguish at least some of the species of bumblebees (*Bombus*) known or expected to occur in the Park. Out of 9 species known from eastern Canada, 5 species are known from the Park, but 7 species are expected to occur. Adults can be found in open habitats anywhere in the Park (bogs, barrens, meadows, prairies and fields). Adults of *B. terricola* Kirby and *B. vagans* Smith are the two commonly observed species in the Park.

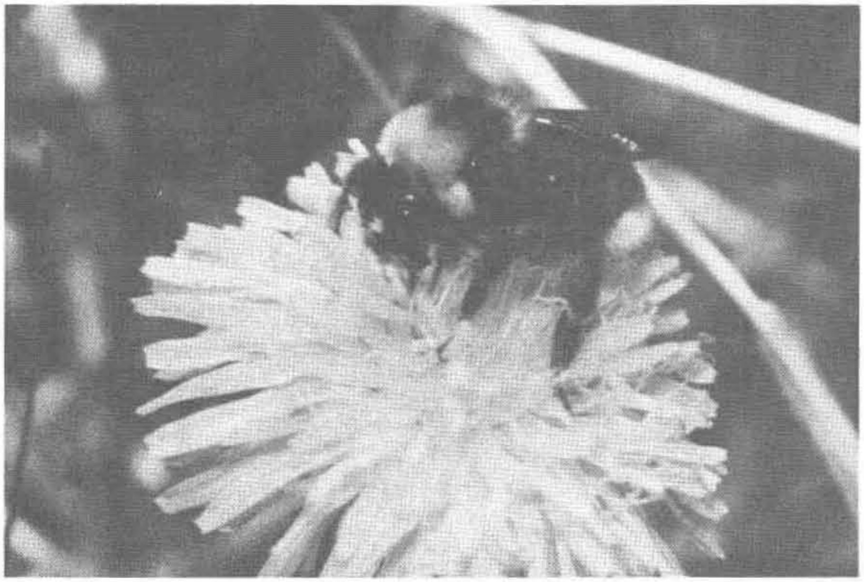


Fig. 17. Worker of *Bombus bimaculatus* Cresson gathering pollen and nectar

Bumble bees are the most obvious of our pollinating insects. Queens or workers feed on a very wide range of flowering plants. Early in spring, soon after the snow melts, queens come out of overwintering quarters and busily collect pollen and nectar for a new colony. After rearing the first colony, the queen settles in the nest where she lays eggs. The first brood consists of very small individuals, but those of later broods are larger. In late summer, the colony will have some males in addition to workers. Soon after the males are mature, the queens in the nest mate. Only the queens will overwinter.

Workers of all species of the Park are easily distinguished from each other by color patterns. *B. ternarius* Say (abdominal terga 2 and 3 reddish brown), *B. bimaculatus* Cresson (abdominal terga 1 to 3 mostly black and 4 golden), *B. terricola* Kirby (abdominal tergum 1 black, and terga 2 and 3 golden), *B. vagans* Smith (abdominal terga 1 and 2 golden, and side of thorax black) and *B. perplexus* Cresson (abdominal terga 1, 2 and 6 golden, and side of thorax golden)

The honey bee (*Apis mellifera* L.) is the only truly domesticated bee in North America. Honey bees are very rare in the Park. Although swarms of honey bees may occasionally escape the beekeeper's control, they can hardly survive the harsh Canadian winter in the wild.

References

Akre, R.D. *et al.* 1981. The yellowjackets of America North of Mexico. U.S. Dept. Agr. Agriculture Handbook No. 552.

Finnamore, A.T. 1982. The Sphecoidea of southern Quebec (Hymenoptera). Lyman Entomological Museum and Research Laboratory, Memoir No. 11: 348 pp.

Goulet, H. In press. The genera and species of the Nearctic Dolerini (Hymenoptera: Tenthredinidae: Selandriinae): classification and phylogeny. Mem. Can. Ent. Soc.

Huggert, L. 1980. Taxonomical studies on some genera and species of Platygastridae (Hymenoptera: Proctotrupoidea). Ent. Scan. 11: 97-112.

Krombein, K.W., *et al.* 1979. Catalog of Hymenoptera in America. Symphyta and Apocrita (Parasitica). Smithsonian Institute Press, Washington, D.C. 1: 743-1043.

MacGown, M.W. 1979. The Platygastridae (Hymenoptera: Proctotrupoidea) parasitic on midges (Cecidomyiidae) found on conifers in Canada and the United States. Miss. Agric. Forest. Exp. Sta., Inf. Bull. 9, 131 pp.

Masner, L. 1962. On the *Trimorus* species of the *ninus* (Nixon)-group (Hymenoptera: Scelionidae). Acta Zool. Acad. sci. Hung. 8: 107-113.

Masner, L. 1964. A comparison of some Nearctic and Palearctic genera of Proctotrupoidea (Hymenoptera) with revisional notes. Acta Soc. ent. Cechosl. 61: 123-155.

Masner, L. 1972. The classification and interrelationships of Thoronini (Hymenoptera: Proctotrupoidea, Scelionidae). Can. Ent. 104: 833-849.

Masner, L. 1976a. The Nearctic species of Iphitrachelus Walker (Hymenoptera, Proctotrupoidea, Platygastridae), with a key to world species. Can. Ent. 108: 1065-1068.

Masner, L. 1976b. A revision of the Ismarinae of the New World (Hymenoptera, Proctotrupoidea, Diapriidae). Can. Ent. 108: 1243-1266.

Masner, L. 1980a. Key to genera of Scelionidae of the Holarctic region, with descriptions of new genera and species (Hymenoptera: Proctotrupoidea). Mem. Ent. Soc. Can. 113, 54 pp.

Masner, L. 1980b. The Nearctic species of Acerotella Masner (Hymenoptera, Proctotrupoidea, Platygastridae). Can. Ent. 112: 1291-1303.

Masner, L. 1981. Revision of the Nearctic species of Metaclisis Foerster (Hymenotpera, Platygastridae, Inostemmatinae). Can. Ent. 113: 1069-1091.

Masner, L. 1983. Revision of the Nearctic species Trichacis Foerster (Hymenoptera: Proctotrupoidea: Platygastridae). Can. Ent. 115: 1071-1093.

Masner, L. *in* H.V. Danks (Ed.). 1979. Proctotrupoidea, *in*: Canada and its insect fauna. Mem. ent. Soc. Can. 108: 499-500.

Masner, L. and P. Dessart. 1967. La reclassification des categories supérieures des Ceraphronoidea (Hymenoptera). Bull. Inst. r. Sci. nat. Belg. 43: 1-33.

McAlpine, J.F. and J.E.H. Martin. 1969. Canadian amber - a paleontological treasure-chest. Can Ent. 101: 819-838.

Miller, C.D.F. 1961. Taxonomy and distribution of Nearctic *Vespula*. Can Ent. 93: 52 pp. (Supplement 22).

Mitchell, T.B. 1962. Bees of eastern United States. The North Carolina Experimental Station. 557 pp.

Muesebeck, C.F.W. *in* K.V. Krombein (Ed.). 1979. Catalog of Hymenoptera of North America North of Mexico. Vol. 1, 1198 pp., Smithsonian Institution Press, Washington, D.C.

Smith, D.R. 1979. Suborder Symphyta. In K.V. Krombien, P.D. Hurd Jr., D.R. Smith and B.D. Burks. Catalog of Hymenoptera in America North of Mexico. Vol. I. Smithsonian Institution Press, Washington, D.C. 16 + 1198 pp.

Townes, H.K. and M.C. Townes. 1981. A revision of the Serphidae (Hymenoptera). Mem. Amer. Ent. Inst. No. 32, 541 pp.

Yoshimoto, C.M. 1979. 46 Hymenoptera: Chalcidoidea and Cynipoidea. Pages 496-498, in H.V. Danks (ed.). Canada and its insect fauna. Mem. ent. Soc. Cna. Vol. 108.

Yoshimoto, C.M. 1983. Review of North American *Pnigalio* Schrank (Hymenoptera: Eulophidae). Can. Ent. 115: 971-1000.

Yoshimoto, C.M. 1984. The Insects and Arachnids of Canada. Part 12. The Families and Subfamilies of Canadian Chalcidoid wasps. Hymenoptera: Chalcidoidea. 1-149 pp.

Weld, L.H. 1952. Cynipoidea (Hym.) 1905-1950 being a Supplement to the Dalla Torre and Kieffer monograph -- the Cynipidae in Das Tierreich, Lieferung 24, 1910 and bringing the systematic literature of the world up to date, including keys to families and subfamilies and lists of new generic, specific and variety names. Ann Arbor, Michigan, Privately Printed. 1-351 pp.

PART III ARTHROPODS OF SELECTED MAJOR HABITATS

Introduction

by J.D. Lafontaine

The varied habitats of Cape Breton Highlands National Park support a rich and diverse arthropod fauna. Arthropods abound in almost every habitat in the Park, some species characteristic of particular habitats and others more generally distributed. The fertile valleys of the Cheticamp and Grande Anse Rivers support a particularly rich and diverse fauna but other areas of the Park, such as coastal dunes and scrub, upland conifer forests and highland bogs, all contain an abundance of arthropod species. Some very specialized habitats, such as the pitchers of the pitcher plant, or wrack cast up on the seashore, contain only a few species but the species of such specialized areas are frequently rare and fascinating to study.

The distribution of arthropod species in the Park does not appear to correspond to the two broad zones of land classification, namely the "Acadian Land Region" and the "Boreal and Taiga Land Regions". For example, various types of ponds, streams, springs, etc., each have characteristic species but the distributions are dependent in details of the habitat, not on location in one of the two land regions. Perhaps insects and other arthropods can disperse too readily for the fauna associated with such areas as conifer forests or bogs to differ significantly between the Acadian and Boreal Land Regions. Small proctotrupid wasps only a few millimeters long that parasitize insects restricted to sugar maple were collected in traps in a bog on North Mountain about five kilometers from the Lone Shieling sugar maple stands.

In general, species diversity in a given habitat decreases with increasing elevation in the Park. The highland barrens do not contain the specialized fauna that would be associated with similar habitats farther north. The fauna of the barrens is surprisingly depauperate and consists mainly of bog and boreal forest species that are able to live in the harsher conditions in the barrens. Reasons for the lack of more northerly species in the barrnes would make an interesting study in itself. The habitat may not have remained stable through time, or fire may have had an important influence. Similarly, dwarf black spruce stands in the barrens did not contain any species restricted to them but consisted simply of a fraction of the species that occur in the more extensive black spruce stands at lower elevations. It is interesting to note that the localities for most arctic or alpine plants in the Park are not in the highland barrens but are on north facing cliffs and canyon walls.

The following chapters describe the characteristic and unusual arthropod species of most major habitats in the Park.

Arthropods associated with the forest habitats

by P.T. Dang

Cape Breton Highlands National Park lies on the northern limit of the Acadian forest region. Forests in the Park can be clearly divided into two main types: the Cape Breton Antigonish, or lowland forests and the Cape Breton Plateau, or highland forests. The distribution of most forest dwelling insects species in the Park is very much in parallel with that of plants which, for the majority of cases, serve as their main sources of food and shelters.

The Cape Breton Antigonish forests occupy most parts of the Cape Breton Island, including lowland areas, rolling hills and slopes, or ravines adjacent to the highland portion of the Park. In the lowland areas where the drainage is poor and the soil is acidic, the forest comprises mainly black spruce, balsam poplar and white ash. By contrast, balsam fir, white spruce and various species of maple and birch occur on hill sides and higher areas (Lone Shieling, McIntosh Brook and neighboring areas of Cheticamp). In the northern and western slopes of the Park, the forest is mainly deciduous, consisting mainly of red and sugar maple, yellow birch, beech, etc., and a few scattered patches of balsam fir, eastern white pine, white spruce and eastern hemlock. In the slopes or ravines adjacent to the plateau, hemlock is abundant in moist areas, and beech on drier slopes. Red oak, aspen, white birch and jack pine occur locally in isolated pockets. Red spruce is uncommon in the CBHNP.

Forests in the Cape Breton Plateau of elevations from 400 to 500 m are of the maritime boreal type, consisting mainly of black and white spruce, balsam fir, tamarack, mountain ash and white birch. The forests on top of the plateau in particular, become fragmented and discontinuous into patches separated by peat bogs and barrens.

The forest habitats in the Cape Breton Highlands National Park harbor a great number of insect and arachnid species (species marked with an asterisk * are expected to occur in the Park) whose distribution can be distinguished in 5 main vertical levels:

1) On the forest floors, regardless of forest type, there are a number of poor flying or flightless insects including immature stages and arachnids. Spider and insect species found here are predators. Common spiders found among the leaf litter include *Pirata montanus*, *Robertus banksi* and *Theridiosoma gemmosum*; insect species found among the leaf litter, rotting piles of bark and wood of fallen trees and along edges of creeks or splashing zones of waterfalls include many species of ground beetles (Carabidae): *Sphaeroderus canadensis* Chaudoir, *S. lecontei* Dejean, *S. nitidicollis brevoorti* LeConte, *Trechus crassiscarpus* Lindroth, *T. apicalis* Motschulsky, *Calathus ingratus* Dejean, *Synychus impunctatus* Say, *Pterostichus adoxus* Say, *P. adstrictus* Eschscholtz, *P. coracinus* Newman, *P. tristis* Dejean, *Agonum retractum* LeConte, and *A. decentis* Say; rove beetles (Staphilinidae): *Coryphium nigrum* Campbell, *Trigonodemus striatus*

LeConte, *Tricophya pilicornis* Gyllenhal, and *Brathinus nitidus* LeConte; longhorn beetles (Cerambycidae): *Anthophylax attennatus* (Haldeman), in decaying hardwood, *Cyrtophorus verrucosus* (Olivier), in dead and fallen deciduous trees, *Tragosoma depsarius* (Linnaeus), in dead and decaying pine logs; bark beetles (Scolytidae): *Crypturgus borealis* Swaine, in fallen branches and trunks of spruce, *Dryocoetes affaber* (Mannerheim), *D. autographus* Ratzeburg, both in dead and decaying spruce, *Ips borealis* Swaine and *Orthotomicus caelatus* Eichhoff, in dead or fallen trunks of spruce, *Pityogenes hopkinsi* Swaine, in dead or fallen trunks of white pine, *Scierus annectans* LeConte, in dead logs of spruce, fir and pine, and *Scolytus piceae* Swaine, in green fallen branches of spruce; and terrestrial hydrophilids (Hydroplilidae): *Sphaeridium scarabaeoides* (Linné), *Cercyon lateralis* (Marsham), *C. haemorrhoidalis* (Fabricius) and *C. assecla* Smetana in animal droppings and other decaying organic matters.

2) The understory vegetation comprises mainly mosses, mushrooms, ferns and tree seedlings. Commonly found here are spiders species, *Enoplognatha ovata* and *Theridion frondenum* with their characteristic tangle cobwebs between branches of shrubs; predaceous rove beetles (Staphilinidae): *Oxyporus lateralis* Grav., *Philonthus cyanipennis* Fabricius on mushrooms, a few moss feeding Microlepidoptera, especially the common pyralid *Scoparia basalis* Walker; the black leafhopper (Homoptera): *Eupteryx flavoscuta* (Gillette) on ferns; sawfly (Hymenoptera) of the following species: *Strongylogaster soriculatipes* Cresson, *S. remota* Rohwer, *S. macula* (Klug) on ferns, *Ametastegia pallipes* (Spinola) and *Nefusa ambigua* (Norton) on *Viola* sp., and *Dolerus elderi* Kineaid and *D. gilvipes albifrons* (Norton) on horsetails, *D. hebes* Goulet on grasses and *Phymatocera smilacinae* Smith on *Smilacina* sp.

3) A number of flying insect species can be found in the open space under the forest canopy, and around clearing areas during the spring and summer. They include the dayflying Lepidoptera such as the white admiral *Basilarchia arthemis* (Drury), the tiger swallowtail *Papilio glaucus canadensis* R & J. and the Atlantis fritillary *Speyeria atlantis* (Edw.); a large number of Hymenoptera, sawfly of the following species: *Pamphilius quebecensis* (Provancher), *Arge* spp., *Croesus latitarsus* Norton, *Caulocampus matthewsi* Smith, *Phymatocera smilacinae* Smith, *Stethomostus fuliginosus* (Shrank) and *Taxonus pallicornis* (Norton); a number of Diptera species, most of which are annoying man biting pests whose larvae are aquatic, living in pools and creeks in the forest; they include a number of mosquitoes (Culicidae) such as *Aedes canadensis* (Theobold), *A. abserratus* (Felt & Young), *A. atropalpus* (Coquillet), *A. communis* (DeGeer), *A. decticus* Howard, Dyer and Knap and *A. punctor* (Kirby), black-flies (Simuliidae) such as *Prosimulium fuscum-mixtum* complex, *Simulium venustum* Say, *S. corbis* Twinn, *S. parnassum* Malloch, and *S. aureum* Fries, sand flies (Ceratopogonidae) such as *Culicoides sanguisuga* and horse and deer flies (Tabanidae) such as *Hybomitra zonalis* (Kirby), *H. epistates* (Osten Sacken), *H. typhus* (Whitney), *H. pecheumani* Teskey & Thomas, *H. nuda* (McDunnough), *Chrysops excitans* Walker, *C. ater* Macq., *C. calvus* Pech. & Teskey, *C. sordidus* Osten Sacken, *C. frigidus* Osten Sacken, *C. laterlis* Wied. and *C. furcatus* Walker.

4) Tree trunks serve as good resting place for many species of insects, many of which exhibit specialized body colors and patterns that camouflage well to the texture and colors of the bark; some of these species, on the other hand, are trunk or bark borers feeding on living wood, at times causing serious damage to, or even killing the host tree. These pest species include the Hymenoptera: the horntails *Urocerus albicornis* (Fabricius) and *Sirex cyaneus* (Fabricius), larvae of these species are spruce and balsam fir trunk borers, *Xiphydria maculata* Say whose larva is maple trunk borer, *X. mellipes* Harris whose larva is beech, birch and alder trunk borer; Lepidoptera: the carpenterworm, *Prionoxystus robiniae** Peck (Cossidae), whose larva is poplar trunk borer, the Zimmerman pine moth *Dioryctria zimmermani** (Grote) (Pyralidae), whose larva is spruce and white pine trunk borer, the last two are commonly found in eastern Canada including some parts of Nova Scotia; Coleoptera: The longhorn beetles (Cerambycidae): *Evodinus monticola* (Randall) whose larvae found under bark of *Tsuga, Abies, Picea* and *Pinus* spp., *Saperda concolor* LeConte whose larva is poplar and willow stem or branch borer, *Tetropium cinnamopterum* Kirby, commonly known as eastern larch borer, whose larva is found boring under bark of living or dead coniferous trees especially larch and spruce; and a number of bark beetles (Scolytidae): *Cryphalus ruficollis* Hopkins, larvae found under bark of small branches of spruce and fir, *Crypturgus borealis* Swaine, larvae found boring in trunks or large branches of spruce, *Dendroctonus rufipennis* (Kirby), a serious and most destructive pest of various species of spruce, *Hylurgopinus rufipes* (Eichnoff)* known as native elm bark beetle, *Monarthrum mali* Fitch, both larvae and adults found in sapwood of various deciduous trees, *Pityokteines sparsus* LeConte larvae found in large branches of balsam fir, *Xyleborus dispar* (Fabricius) and *Xyloterinus politus* (Say), both found in most deciduous trees, and *Trypodendron lineatum* (Olivier), found in dead or dying spruce and jack pine.

5) Foliage of deciduous and coniferous trees serves as main source of food to a great number of insects species occurring in the CBHNP. In the lowland deciduous and coniferous forests such as those in Lone Shieling, McIntosh Brook, Cheticamp areas etc., the insect community occurring in this level represents the most abundant and important insect species found in the Cape Breton Highlands National Park. Serious pests as well as important predaceous and parasitic insects are abundantly found here in various development stages of their life cycle, in which larvae can be easily observed and their feeding habits can be positively determined; the adults on the other hand can be most often seen resting among the foliage, or flying about the tree canopy during the day, nearby their natural hosts. Insects found in this level in the lowland forests can be segregated into 2 groups:

A) Insects associated with deciduous trees include species of the following orders:

(1) Lepidoptera.

Tortricidae: Tortricid larvae usually occur and feed vigorously in the early Spring to early part of the summer, adults appear later from June to September. Larvae are external feeders, rolling and webbing a single or cluster of leaves of the host plant into characteristic tubelike nests for shelters hence they are commonly known as leafrollers or tiers. The most common tortricid species found in the Park consist of the oblique banded leafroller *Choristoneura rosaceana* (Harris), the large aspen tortrix *C. conflictana* (Walker), both are widespread across Canada feeding widely on most decidous tree species, *Hedya ochroleucana* (Frolich), *H. nubiferana* (Haworth), both are widespread in the holarctic region feeding on mountain ash, oak and maple, the uglynest caterpillar *Archips ceracivorana* Fitch, a widespread species across Canada, whose larvae live in colonies, web and construct a large nest of cluster of leaves of cherry, birch, poplar, basswood and maple and feed inside, the fruittree leafroller *Archips argyrospila* Walker, and *A. purpurana* Clemens are pests of poplar, basswood, maple, birch, apple, etc. across Canada and northern parts of the United States.

Geometridae: Geometrid larvae, commonly known as inch worms, are among common Lepidoptera found in the deciduous forests in the Park. Geometrid larvae are external and solitary feeders, their body colors and patterns camouflage well with the host foliage, some larvae also mimic dead twigs or stems making them fairly invunerable to predators. Geometrid moths are readily attracted to light at night, they can be seen in a good number around lighted areas in the Park such as campsites and warden offices. Most common Geometrid species found in the deciduous forests in the Park include *Alsophila pometaria* Harris, and *Erannis tiliaria* Harris, both are general feeders of a great variety of trees such as basswood, birch, elm, maple, etc.

Lasiocampidae: The forest tent caterpillar *Malacosoma disstria* Hubner, and the eastern tent caterpillar *M. americana* (Fabricius) are common in the Park; the caterpillars of these two species built mats or tents of dense web and congregate in a large cluster. They are general leaf feeders of most species of deciduous trees, usually defoliating and inflicting great damage to the host.

Saturniidae: The polyphemus moth *Antheraea polyphemus* (Cramer) is the largest Lepidoptera found in the Park, the wing span can reach 15 cm; the species can be easily identified by a large and conspicuous eye spot on the hindwing. The larva of this species feeds on foliage of a wide variety of trees and shrubs.

Notodontidae: Caterpillars of most notodontid species feed on the foliage of deciduous trees and shrubs. Those of the majority of species that have been found in the Park feed on aspen. These include *Costera albosigma* Fitch, *Gluphisia septentrionalis* Walker, *Odontosia elegans* (Strecker), *Furcula cinerea* (Walker), and *Pheosia rimosa* Packard. A number of other species associated with birch and beech include *Nadata gibbosa* (J.E. Smith), *Peridea ferruginea* (Packard), *Schizura ipomoeae* Doubleday and *Oligocentria lignicolor* (Walker). A few species are general feeders on most deciduous tree species occurring in the Park, such as *Schizura leptinoides* (Grote) and *Heterocampa guttivitta* (Walker).

Lymantriidae: Five species of this family were collected in the Park, of which four (two introduced and two native) can be important pests of deciduous trees. The rusty tussock moth *Orgyia antiqua* (Linnaeus) possesses short and broad, rusty-orange wings in the male; females are wingless. The larvae are known to feed on a wide variety of trees and shrubs including both coniferous and deciduous trees. The whitemarked tussock moth *O. leucostigma* (J.E. Smith) is similar to *O. antiqua* but the wings are gray-brown. The caterpillar feeds most commonly on conifer trees such as balsam fir and white spruce but may also be found on such deciduous trees as white birch and red maple. The two introduced species are the satin moth *Leucoma salicis* (Linnaeus), which is sometimes a pest on poplar and willow, and the gypsy moth *Lymantria dispar* (Linnaeus), which is still rare in the Cape Breton Highlands but has only recently moved into the area. It remains to be seen whether or not it will become a serious pest in deciduous forests of the maritime Canada.

Noctuidae: Although the Noctuidae is one of the largest insect families in the Park, with possibly 300 species, relatively few are associated with forested habitats. The majority of noctuid species are cutworms which live on or near the ground and feed on herbaceous plants. The caterpillars of two subfamilies, the Pantheinae and Acronictinae feed on the foliage of trees; the following common species found in the Park are general feeders on poplar, birch and willow: *Charadra deridens* (Guenée), *Raphia frater* Grote, *Acronicta dactylina* Grote, *A. innotata* Guenée, *A. grisea* Walker, *A. superans* Guenée, and *A. fragilis* (Guenée); the caterpillars of these species are hairy and resemble those of of "woollybears" but with additional tufts of longer hairs on the body.

Papilionidae: The caterpillar of the tiger swallowtail *Papilio glaucus canadensis* R.&J. is a solitary feeder on birch and poplar foliage. It can be easily distinguished by the pair of characteristic eye spots on the dorsum of the largely swollen thorax. The brightly yellow butterfly with contrasting black tiger stripes is a strong flier and can frequently be seen during the day in various areas in the Park.

Nymphalidae: The caterpillar of the white admiral *Basilarchia arthemis* (Drury) can be commonly found in the hardwood forest feeding on poplar, birch and willow foliage. The butterfly can be seen during the day, gliding high in the open or along edges of the forest.

Leaf mining Lepidoptera: There are very few leafmining species actually recorded in the Park, however, the vegetation and the habitats in the Cape Breton Highlands National Park no doubt support a large number of species of Nepticulidae, Tischeriidae, Heliozelidae, Gracillariidae, Lyonetiidae, Elachistidae, Gelechiidae, etc. Larvae of these families are small, often host specific, and live and feed between the upper and lower epidermis of the leaf of the host leaving mine patterns that are species specific. Collecting and survey of these insects require specialized techniques and are therefore highly recommended for any future insect study project in the Park .

(2) Hymenoptera.

Most Hymenopterous insects found in the Park were collected mainly by trapping and sweeping and many represent new records to Nova Scotia and CBHNP.

Pergidae: *Acordulecera mellina* MacGillivray and *A. dorsalis* Say larvae are often found feeding on the foliage of red oak.

Cimbicidae: Sawfly larvae of *Trichiosoma triangulum* Kirby and *Cimbex americana* Leach feed on leaves of maple, birch, alder, poplar, ash, willow and cherry.

Tenthredinidae: Tenthredinid sawfly larvae are external feeders on leaves of deciduous trees in the Park; they include *Caulocampus acericaulis* (MacGillivray) on maple; *Priophorus betulae* Rohwer, *Croesus latitarsus* Norton, *Fenusa pusilla* (Lepeletier), *Heterarthrus nemoratus* (Fallen), *Dimorphopteryx melanognatus* Rohwer, *Empria multicolor* (Norton), *Pristiphora cincta* Newman, *P. siskiyouensis* Matlatt, *Tenthredo concessa* Norton and *T. semirufa* Norton on birch.

Platygastridae: The following species were collected: *Platigaster* spp., parasites of sugar maple gall midges; *Isocybus canadensis* Prov., a parasite of *Carex* sp. found along creek in Lone Shieling; *Trichacis virginiensis* Ashm., *Amblyaspis* sp., *Inostemma* sp., *Euxestonotus* sp., *Anopedias* sp., *Acerotella aceris* Msn. and *Metaclisis acericolo* Msn., the last two associated with sugar maple.

Diapriidae: The following species were collected: *Spilomicrus bifoveatus* Kieff, a new record to Canada, *Spilomicrus* sp., an undescribed species, and species of various other genera of the family.

Aphidiidae: *Ephedrus imcompletus* (Prov.) and *Praon pequodorum* Vier. and *P. occidentalis* Baker are parasites of aphids that are common in the Park, especially at Lone Shieling.

Ichneumonidae: *Neurateles* sp., a parasite of Fungivoridae associated with maple; *Pimpla aquilonia* Cresson, a parasite of various Lepidopterous larvae feeding on maple and birch; *Syrphophilus tricinctus* (Ashm.), a parasite of Syrphid larvae predator of aphids on maple; *Diplazon tetragonus* (Thunberg), a parasite of Syrphid puparia on maple, were the most common Ichneuminids in the Park; *Agrypon provancheri* (Dalla Torre) was also common; it is a parasite of Geometrid moth larva *Operophtera bruceata* on aspen and willow.

Braconidae: An unknown species of *Alloxyta* was collected; it is a parasite of species in the parasitic Hymenoptera subfamily Aphidiinae.

Chalcidae: *Polynema* sp., an egg parasite of other insect species and *Halticoptera* sp., a parasite of Agromyzid leafminer, are found in deciduous forests.

(5) Diptera. Dipterous insects, or flies, found in this level include the following families:

Tachinidae: Tachinid larvae are parasites of immature stages of a variety of other insects. *Winthemia fumiferana* Toth., *Madremyia saundersii* (Walker), *Hemisturmia tortricis* (Coquillet), *Ceromasia aurifrons* Ths. and *Lypha setifacies* West are among common tachinid parasites of a number of tortricid larvae feeding on deciduous trees. The flies can be commonly seen flying around, or resting on the tree foliage searching for hosts.

Syrphidae: Syrphid flies, *Dasysyrphus venustus* (Meigen), *Syrphus torvus* Osten Sacken and *Metasyrphus lapponicus* (Zett.), are commonly seen flying or hovering around the tree canopy; the larvae are predaceous feeders on various species of aphids.

Cecidomyidae: Unlike the previous two families, cecidomyid flies are pests that produce characteristic galls on the host plant; the most common species found in the deciduous forest include *Acericeris ocellaris*, whose larvae feed on maple and produce characteristic red spot galls.

B) Insects associated with coniferous trees in the lowland forest areas include species of the following orders:

(1) Lepidoptera.

Coleophoridae: The introduced European larch case bearer *Coleophora laricella* (Hubner) has become a very widespread pest across Canada; the tiny larva mines, feeding on the internal tissues of the needle and carries the hollow needle as a protective case for the rest of its life cycle. At times, a large number of larvae can be found on tamarack foliage causing serious defoliation to the host later in the season.

Tortricidae: The spruce budworm *Choristoneura fumiferana* (Clem.) represents the most destructive pest of balsam fir and various species of spruce in the lowland forest areas; the larvae can be seen devouring new spruce and fir buds from early May to mid June, and the moths can be seen flying around the canopy from late June to August. The pine budworm *C. pinus*, a relative of the spruce budworm, can be found in the jack pine forest located just north of Black Brook. The black headed budworm *Acleris variana* (Fernald), the spruce budmoths *Zeiraphera canadensis* Mutuura & Freeman, *Z. unfortunana* Powell, are at times serious pests of black and white spruce; the larvae of theses species feed inside spruce buds in the early spring. The larch budmoth *Z. improbana* (Walker), and the eyespotted budmoth *Spilonota ocellana* (D. &S.), can at times be serious pests whose larvae feed on tamarack needles. Other important spruce feeding Tortricids commonly found in the lowland forests include *Archips alberta* (McDunnough), *A. striana* (Fernald), and *A. packardiana* (Fernald).

Pyralidae: Larvae of *Dioryctria reniculelloides* Mutuura & Monroe are abundant; they are found associated with spruce budworm and budmoths feeding on young buds of spruce and balsam fir. *Dioryctria* larvae also bore in spruce and fir cones.

Geometridae: Larvae of *Nyctobia limitaria* Walker, *Hydriomena divisana* Pack., *Protoboarmia porcelaria indicataria* Walker, *Ectropis crepuscularia* Schiff. and *Semiothiosa sexmaculata* Pack. are most commonly found feeding on balsam fir, spruce, hemlock and tamarack.

Lymantriidae: Three species of tussock moths may be pests of coniferous trees. All are general feeders on almost all species of conifers but each usually prefers some species of conifers over others. As mentioned above, *Orgyia antiqua* and *O. leucostigma* caterpillars feed on almost every species of deciduous and coniferous trees that occurs in the Park. The pine tussock moth *Dasychira plagiata* (Walker) caterpillar feeds on pine and all other conifer species in the Park.

(2) Hymenoptera.

Diprionidae: *Gilpinia hercyniae* (Hartig) larvae feed on the spruce foliage.

Tenthredinidae: *Pikonema alaskensis* (Rohwer) and *P. dimmockii* (Cresson) larvae feed on the spruce foliage.

Platygastridae: *Platygaster beneficiens* MacGown is a parasite of spruce cone gall midges.

Ichneumonidae: *Campoplex conocola* (Rohwer) is a parasite of a variety of Pinaceae feeding Microlepidoptera, especially *Dioryctria zimmermani* (Grote); *Glypta fumiferana* (Vier.) is a common parasite of the spruce budworm.

(3) Homoptera.

Aphidae: Aphids of the genus *Cinaria* are fairly common on white spruce. Colonies are often seen on main stems of young trees.

Adelgidae: Gall producing *Adelges* sp. is also common on white spruce, especially in the Lone Shieling, Pleasant Bay and Warren Lake areas.

(4) Diptera.

Tachinidae: Tachinid flies listed for deciduous forests can also be found in this habitat where they parasitize conifer feeding tortricid larvae such as those of the spruce budworm, spruce budmoths and *Archips* spp.

Syrphidae: The three syrphid flies, previously mentioned under deciduous forests, can also be found here as predators of aphid and *Adelges* species.

Cecidomyidae: A large number of *Anarete* sp. can sometimes be observed as they swarm near the tips of branches of various conifers.

Forests in the boreal and taiga regions comprise mainly black and white spruce, balsam fir and tamarack. Most insects associated with the spruce, fir and tamarack in the lowland forests are also expected to occur there. The damage to the spruce and fir forests in this zone, especially those in the French and North Mountains areas by the spruce budworm, is much more prominent and obvious than that in the lowland forests and can readily be seen from the Cabot Trail highway. Over 70% of trees in the area are dying or have been killed by this pest. Many Hymenoptera were collected in this forest zone (North Mountain, MacKenzie Mountain, and Skyline Trail) by trapping and sweeping. Some are newly recorded to Canada, or appear to be undescribed, including species of the following families:

Platygastridae: *Acerotella aceris* Msn., *Fidiobia* sp. (undescribed), a number of *Platygaster* species, *Euxestonus* sp. and *Leptacis* sp.

Driapriidae: *Spilomicrus formosus* Janss. (new record to Nova Scotia), *Ismacrus halidayi* Foerster, *Basalys* sp., *Paramesius* sp., *Entomacis* sp., *Coptera* sp., several species of *Trichopria*, *Polypeza pergandei* Ashm., *Miota* sp., *Macrohymis* sp., *Opazon* sp., *Zygota* sp.

Scelionidae: *Trimorus* sp., *Idris* sp. (undescribed).

Proctotrupidae: *Cryptoserphus flavipes* (Prov.), and a number of *Codrus* species.

Aphidiidae: *Binodoxys rhagii* Ashm., a parasite of aphids, newly recorded to Nova Scotia.

Ichneumonidae: *Dusona semirufa* (Prov.), a parasite of Noctuid moth larva *Pheosia rimosa* Pack.; *Olescampe* sp., a parasite of sawflies, commonly found at MacKenzie Mountain; *Scolobates auriculatus* (Fabricius), a parasite of species of sawflies of the genus *Arge* feeding on birch; *Phaeogenes maculicornis* (Stephens), a parasite of *Choristoneura fumiferana* and *C. conflictana* feeding on spruce, balsam fir and birch, the species was introcuded to Ontario from Europe for controlling the spruce budworm.

Arthropods of freshwater wetlands

by K.G.A. Hamilton

Freshwater wetlands include any ground saturated by freshwater, or covered with freshwater which has emergent vegetation: lake edges, marshes, fens, bogs, mires and swales. In the Park the most common type of freshwater wetland is fen with dense spaghnum mats that hold most of the water; these are usually referred to as "bogs" although they are nutrient-richer, have more standing water and grassy cover. There is, however, no standard fauna for Park wetlands. These faunas vary in important species from location to location without apparent correlation with either flora or environment. The number of the wetlands accessable for survey work is very small compared to the number of bogs throughout the entire Park, and consequently only a portion of this important and distinctive habitat is represented in this report.

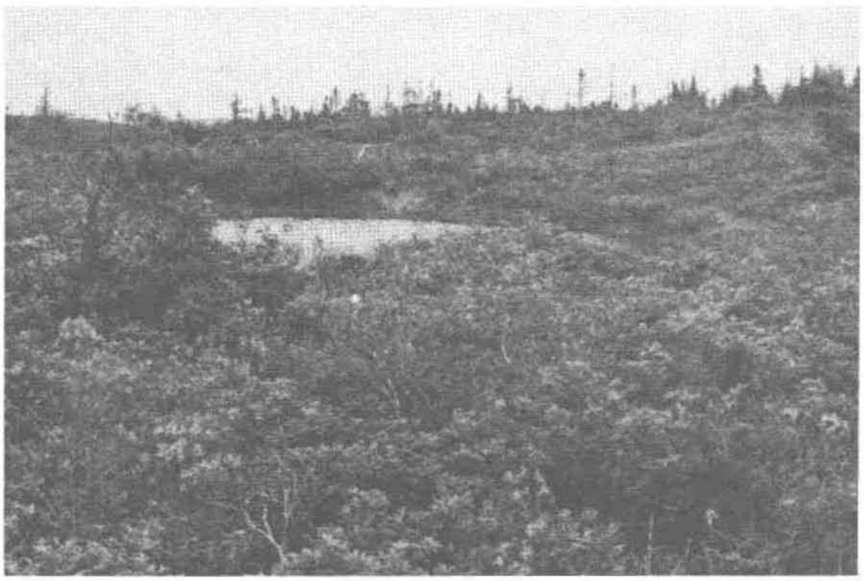


Fig. 18. Bog pond on French Mountain

The fauna of freshwater wetlands is usually considered to be depauperate compared to low elevation woodland faunas. However, sawflies (Symphyta), leafhoppers (Cicadellidae) and some groups of flies (Diptera) are particularly well represented with unique and characteristic species. The wetlands of the Park are among the best in North America for these groups. For example, over 40 species of leafhoppers inhabit wetlands in the Park and 33 are known from fens; thus roughly a quarter of the family are fen dwellers. This contrast with lower numbers in Newfoundland (c. 24 species) and fewer than a dozen in other parts of North America. Only about 3 leafhopper species found in bogs in other parts of Canada have not been found in the Park.

On the other hand, beetles (Coleoptera) are very poorly represented in Park wetlands.

Araneae

Spiders are usually distributed throughout ecological zones with little specificity to local conditions, and are consequently seldom restricted to freshwater wetlands. Most of the fen-inhabiting species are also found in spruce woods; these include the common Teridiids *Robertus borealis* (Kaston) and *R. riparius* (Keyserling), and the wolf spider (Lycosid) *Pardosa hyperborea* (Thorell) which is distinguished by the bright yellow band along the entire length of the body. Two species, however, seem to be restricted to bogs and fens: the orb-weaver (Araneid) *Araneus groenlandicola* (Strand), which spins its small webs among ericaceous plants, and the wolf spider *Arctosa raptor* (Kulczynski), which is rare, and lurks among sphagnum moss clumps.

Acari

The oribatid mite fauna of Park wetlands is very diverse, with 49 species in 45 genera and 31 families; typical for the Canadian northlands. The majority of these species are distributed through bogs and forest litter sites, but 3 undescribed species in the genera *Limnozetes, Punctoribates* and *Zetomimus* seem to be restricted to Park fens. These species are found in wet sphagnum moss and are probably feeding on fungi and decaying moss. *Gozmanyina majestus* (Marshall & Reeves), a tiny mite with long, decorative setae, is very common in French Mountain fen; this is the first record of this species in the Maritimes. *Rostrozetes foveolatus appalachicola* Jacot, an oribatid that likes moist habitats, is very abundant in North Mountain fen, where it is probably feeding on the decomposing outer sheaths of roots of plants such as pitcher plant and sedges; this is the first record of this species from Canada.

Homoptera

Aphids are probably common in fens in early summer, since their parasites and hyperparasites have been taken in considerable numbers (see Hymenoptera) but late season collecting failed to turn up any specimens. Ericaceous ("heathy") bogs and fens have the usual heath-feeding leafhopper species *Ophiola vaccinii* (Van Duzee) and *Scaphytopius magdalensis* (Provancher), an all-brown leafhopper with a sharply pointed head. In addition they support the large, redbrown *Idiodonus* leafhoppers, *Ophiola humidus* (Osborn), a small leafhopper with blackish males and bright orange females, and the Heath spittlebug (Cercopid), *Clastoptera saintcyri* Provancher, which is boldly patterned in black and yellow. *Rhynchospora*-covered areas of fens support numerous leafhoppers, including the large, brown *Paraphlepsius fuscipennis* (Van Duzee), *Limotettix sphagneticus* Emeljanov, a pale species with a black band between the eyes, and the unmarked *Macrosteles pallidus* (Osborn). Marshes, lake edges and swales with sedges (*Carex* spp.) have an abundance of Lined spittlebugs, *Neophilaenus lineatus* (L.), and various species of sharp-headed green leafhoppers, *Draeculacephala* spp., which are large, and

Helochara communis Fitch, which is small and often sooty. Where Toad Rush (*Juncus bufonius*) occurs, *Macrosteles fascifrons* (Stal) is always abundant. *Cicadula* spp. and *Limotettix* spp. are also characteristic of swales and fens. Marshes are poorly represented in the part of the Park that was sampled, and these may have their characteristic leafhoppers. Most of the undescribed species of leafhoppers found in the Park were taken from wetlands, or around their edges.

Hemiptera

The only true bugs taken in freshwater wetlands are also generally distributed throughout the Park.

Coleoptera

Beetles are very poorly represented in Park wetlands. A number of species of rove beetles (Staphylinidae) of the genera *Euaesthetus, Lathrobium, Philonthus* and *Stenus* are very common along the edges of fens on North Mountain, but uncommon elsewhere. Five species of leaf beetles (Chrysomelidae) may be found feeding on characteristic plants of wetlands: *Chrysomela mainensis* Bechyné on alder, *Bassareus formosus* Melsheimer on heath plants, *Tricholochmaea kalmiae* (Fall) on lambkill, *T. spiraeae* on meadowsweet, and *T. tuberculata* (Say) on willow. Only 2 water beetles (Hydrophilidae) are characteristic of fens: *Cymbiodyta vindicata* Fall and *C. acuminata* Fall. The leaf beetles *Plateumaris* spp. are relatively abundant among rushes and reeds in swales, ponds and margins of rivers. They are large and metallic: bronze and purplish, coppery, green and blue, or even metallic black.

Diptera

Mosquitoes and black flies in the Park are associated with running water and coastal marshes rather than with freshwater wetlands. One "no-see-um," or biting midge (Ceratopogonidae), *Culicoides sanguisuga*, can be a local scourge. Horse flies and deer flies (Tabanidae) are numerous and diverse. The horse fly *Tabanus marginalis* Fabricius, and the deer flies *Chrysops ater* Macquart, *C. cuclux* Whitney, *C. niger* Macquart, and *C. shermani* Hine inhabit margins of streams, especially backwaters. Some woodland marshy pools, swales and lake edges may have *Chrysops excitans* Walker, *C. frigidus* Osten Sacken, *C. lateralis* Wiedemann and *C. mitis* O.S. as well as the horse flies *Hybomitra affinis* (Kirby), *H. epistates* (O.S.), *H. lasiophthalma* (Macquart), *H. lurida* (Fallen), *H. nuda* (McDunnough), *H. trepida* (McDunnough) and *H. zonalis* (Kirby). Horse flies restricted to bogs and fens include *Atylotus sphagnicola* Teskey, *Hybomitra frosti* Pechuman, *H. longiglossa* (Philip), *H. minuscula* (Hine), *H. pechumani* Teskey & Thomas and *H. typhus* (Whitney), while *H. lurida, H. lasiophthalma* and *H. trepida* may also be found there. The excessively rare *Haematopota rara* Johnson, a horse fly with conspicuously spotted wings, is not uncommon in the Park fens, although its larvae have never been found.

Non-biting flies are numerous and diverse, but difficult to identify. Three species of long legged flies (Dolichopodidae), *Dolichopus* spp., which are found in Park fens, have not been found elsewhere in Canada. Several other species of Dolichopodidae, Syrphidae and Scathophagidae are recorded from the Maritimes only in Park fens. An undescribed species of the parasitic fly (Tachinidae) genus *Lixophaga* was collected from a Park fen; it is probably parasitic on a noctuid moth.

Lepidoptera

Day-flying moths and butterflies are not abundant in fen areas. One Lycaenid, the Bog copper *Epidemia epixanthe* (B. & L.) may be common; its larvae feed on cranberry. A Sphingid, the Hummingbird clearwing moth *Hemaris thysbe* (Fabricius), is a bumblebee mimic that is probably one of the few pollinators of the White-fringed orchid, *Platanthera blephariglottis*. Night-flying moths characteristic of bogs include the Larch casebearer (Coleophoridae) *Coleophora laricella* (Hubner), an introduced European species that often seriously defoliates tamarack; two Tortricids, the Larch bud moth *Zeiraphera improbana* (Walker), and the Eyespotted bud moth *Spilonota ocellana* (D. & S.), which also feeds on tamarack and has a broad, white band across each forewing; and the Noctuid *Lithacodia bellicula* (Hubner) which is restricted to heath bogs. A single specimen of a rare eastern Canadian Noctuid, possibly conspecific with the similarly rare Scandinavian *Lasionycta skraelingia* (Herrich-Schaffer), was taken on a heath bog near the Mackenzie Mountain fire tower.

Hymenoptera

There are no known bees, wasps or ants associated with freshwater wetlands. Sawflies (Symphyta), on the other hand, are very diverse in fens and marshes; 82 such species are recorded from the Park. This represents about a quarter of the number of sawflies in the boreal zone of all of eastern North Amerrica, and about half of all the sawflies in the Park. Common species include *Zaraea americana* Cresson, which has clubbed antennae, *Empria ignota* (Norton) and *Pristiphora cincta* Newman, which is also found on barrens. Three less common species that are distinctive are *Tenthredo leucostoma* Kirby, a large, black sawfly with orange legs, and the white-banded black sawflies *Allantus mellipes* (Norton), with pale legs, and *A. basalis* (Klug), with black legs. *Tenthredo borealis* Kirby and *Allantus basalis* are common in Park fens, although rare elsewhere in Canada. *Strongylogaster rufigastra* (Kincaid) is a very rare western species that is known from eastern North America only from ferns on North Mountain near fen areas.

The remainder of the freshwater wetland Hymenoptera are parasites and hyperparasites. Most are small or difficult to identify, with the exception of *Rhyssa persuasoria* (L.), a large, black and yellow ichneumon with a long ovipositor. Aphid parasites are particularly well represented in fen habitats; about 75% of the bog fauna of eastern Canadian *Aphidius* occur in the Park. Other common fen species include the aphidids *Praon aguti* Smith and *P. occidentalis* Baker, the Ichneumonids *Campoplex* spp., *Itoplectis quadricingulata* (Provancher) and *Apechthis ontario* (Cresson) which are parasites of caterpillars, the Scelionids *Trimorus* spp., egg parasites of ground beetles, the Megaspilids *Dendrocerus* spp., hyperparasites of aphidids, the Platygasterids *Amblyaspis* spp., *Platygaster* spp. and *Synopeas* spp., which are gall midge parasites, and the Diapriids *Entomacis* spp., parasites of biting midges, *Miota* spp., fungus gnat parasites, and an undescribed *Spilomicrus* sp., *Basalys* spp. and *Trichopria* spp., parasites of tabanids and other higher flies.

Insects associated with pitcher plant *Sarracenia purpurea* L.

by A. Borkent

It is common knowledge that pitcher plants trap insects to supplement their diet in the otherwise nutrient poor bog environment. Few, however, appreciate that there is a group of insects that have adapted to the threat of digestion and use the pitcher plant as their principle habitat or food source.

Three species of flies are found in pitcher plants in the Park. A sarcophagid fly, *Blaesoxipha fletcheri* (Aldrich) is found as a maggot in the pitcher fluid, feeding on the carcasses of dead prey trapped by the plant. This fly essentially robs the plant of nutrients it has already trapped. The larvae of the mosquito, *Wyeomyia smithii* (Coquillett), have only been found in the fluids of the pitcher plant. Larvae feed on suspended material in the fluid. Larvae of a chironomid midge, *Metriocnemus knabi* Coquillett feed on bottom detritus and perhaps some of the particulate matter held on the walls of the pitcher. Recent research has shown that the presence of these two species is of benefit to the plant. Both speed up the breakdown of prey and the production of ammonia in the leaves. The leaves absorb both carbon dioxide and ammonia poduced by these insects, and introduces oxygen into the fluid. The insects and plants therefore excercise a mutualistic relationship of benefit to all.

Three species of lepidoptera were recorded from pitcher plants in the park. *Sutyna privata* (Wlk.) was reared from flower heads. *Aphelia alleniana* (Fern.), known to feed on a wide variety of other bog plants, was also recorded from flower heads. Finally, *Exyra rolandiana* Grt., collected on North Mountain, is the only known location for the species in Nova Scotia. Larvae of this moth cut holes in the bottom of pitchers, drain the fluid, and then feed on the inner walls.

Fig. 19. Pitcher plant, *Sarracenia purpurea* in bloom

Arthropods of aquatic habitats

by I.M. Smith

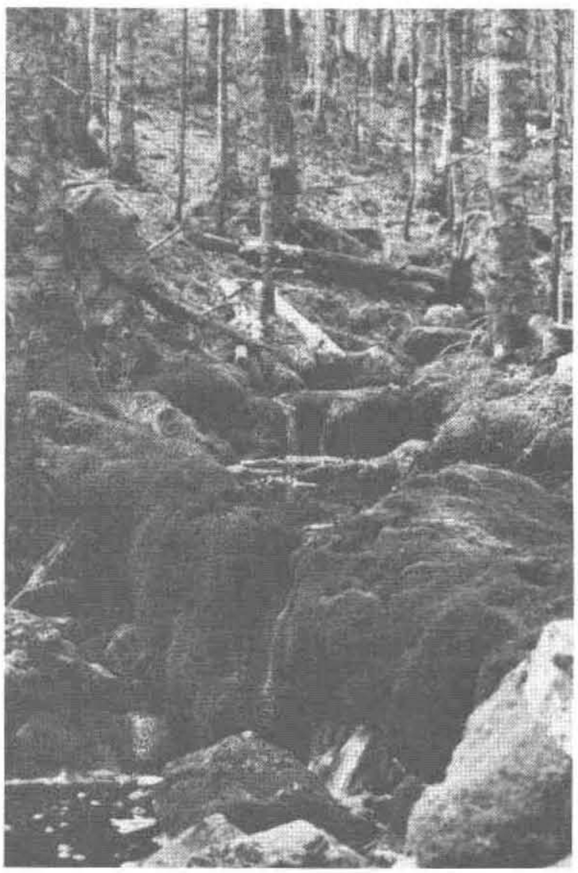
Acadian Land Region

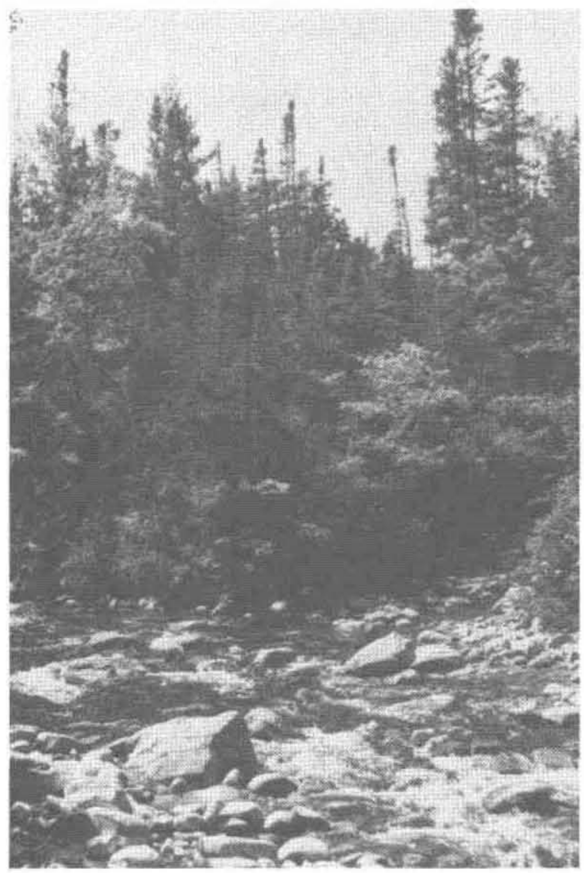
Ponds: Most of the lentic habitats at low elevation in the Park are small, shallow pools formed by the seasonal flooding of rivers and streams. Many of these are temporary and dry up completely by mid June. The fauna of these pools was not well collected, but many of the mosquitoes, chironomid midges, and aquatic beetles found in the Park probably breed there. In wooded areas the flood pools may persist through the summer, providing habitats for another group of species of aquatic insects and water mites. The insects comprise various damselflies and dragonflies, water striders such as the common *Gerris remigis* Say, mayflies, limnephilid caddisflies, water scavenger and diving beetles, and many species of nematocerous flies, notably *Chaoborus americanus* and numerous chironomids. The mite fauna is demonated by various common species of the hygrobatoid genera *Limnesia, Atractides, Hygrobates* and *Piona*, but also includes some relatively species such as *Neolimnochares* n. sp. and *Estellacaras unguitanus* (Habeeb).

Lakes: Warren Lake is fairly typical of the few lakes in this Region, being oligotrophic and acidic, and supporting a rather limited fauna of aquatic insects and mites.

Springs and Seepages: The Acadian Land Region contains a large number of these habitats where resurgent ground water comes to the surface. They are most common along the valleys formed by streams and rivers, and many have water temperates below 10°C The insect and mite faunas associated with spring habitats are highly diversified and abundant. The most characteristic insects are various species of stoneflies and mayflies, caddisflies, hydrophilid beetles, and nematocerous flies such as ceratopogonid, dixid, and chironomid midges. Among the most common mites are *Hydrovolzia mitchelli* Habeeb, *Aturus droueti* Habeeb, *Pseudofeltria multipora* Cook, *Chelomideopsis besselingi* Cook, and species of *Sperchon, Lebertia, Feltria,* and *Hygrobates*, while numbers of other typical spring habitat species such as *Nudomideopsis magnacetabula* (Smith) and *Laversia berulophila* Cook occur more locally in the Park.

Streams: The streams of the Acadian Region are among the most significant aquatic habitats in the Park ranging from spring runs of "first order" streams to small rivers such as Mary Ann River, Clyburn Brook, Mackenzie River and Cheticamp River. Many of these streams closely resemble those found to the





Figs. 20-21. First order stream (left) near Black Brook Cove and small river (right), Mary Ann River

south in the Appalachians, with well developed sand and gravel substrates, and their rich insect and mite faunas reflect these similarities. The insect fauna comprises many eastern boreal species of stoneflies, mayflies, caddisflies, beetles, and especially nematocerous Diptera such as blackflies and chironomid midges. The dominant water mites are members of the genera *Protzia, Sperchon, Lebertia, Torrenticola, Atractides, Hygrobates*, and *Mideopsis*, and several genera of the family Aturidae. A number of rheoplilic species with eastern montane (Appalachian) distributions occur in these streams along with the expected community of species associated with these habitats in boreal, eastern North America. Examples among the insects are the flies *Limnophyes cristilissmus* Saether, *Pseudorthocladius virgatus* Saether and Sublette, *Stilocladius clinopectens* Saether, *Thaumalea americana* Bez., *Diostracus prasinus* Lw., *Spilogena torreyae* Joh., and *Acanthecnema albibarba* Lw. The water mites *Diamphidaxona* sp. (near *pallida* Cook), *Feltria faceta* Cook, *Chappuisides* n.sp.nr. *eremitus* Cook, *Mideopsis (Xystonotus) paramecia* Cook, *Neoacarus similis* Cook, *Volsellacarus* n.sp.nr. *sabulonus* Cook and *Uchidastygacanus acadiensis* Smith also have distributions that are restricted to highland areas of eastern North America, including the Acadian Region of the Park.

Boreal and Taiga land Regions

The Aquatic habitats characteristic of this region are the shallow ponds and lakes associated with acid bogs and fens. The aquatic insect and mite faunas of these habitats are very restricted. The dominant insects are certain species of nematocerous flies, and damselflies and dragonflies, while the most common water mite is *Hydrodroma despiciens* Muller, a species with very broad ecological tolerance.

Arthropods of coastal habitats

by C.D. Dondale

Bounded on the east by the North Atlantic and on the west by the Gulf of St. Lawrence, Cape Breton Highlands National Park features a number of coastal habitats. Stony or sandy beaches, some occupied by extensive kelp beds or other kinds of tidal debris, and some vegetated at the high-tide levels, occur on both coasts. Salt marshes, some traversed by brackish inlets, are found at Ingonish Centre and South Ingonish Harbour. An example of heath-covered headlands is found overlooking French Mountain and the Gulf from the end of the Skyline Trail. An extensive flood plain occurs at the mouth of the Cheticamp River. Each of these habitats supports one or more characteristic insect or arachnid species.

Beach habitats

Bare stony beaches tend to be devoid of arthropods, yet at certain times of year may display an abundance of spiders. Here the black wolf spider *Pardosa groenlandica* (Thorell) may be seen running over cobble-sized stones in mid-summer, mating in the sunshine and feeding on flies that roost there Later, in July, the females ripen their large bluish-green egg sacs, and the young hatch, ride the mother's back for a time, and disperse. Another spider sometimes seen on and between beach stones, on gravel beds, and along stream beds and talus slopes as well, is the similar but smaller spider *Pardosa lapidicina* Emerton. The latter persists as adults into late summer.

The cobblestone beach at Ingonish, between the seashore and the inner lagoon, haboured interesting taxa of oribatid mites, some found nowhere else in the Park. An undescribed species of *Cultroribula* in the superfamily Liacaroidea was found in the moist alder litter on the cobblestones. Two other liacaroid mites, a species near *Dorycranosus acutidens* Aoki and an undescribed species of *Liacarus* were the most common mites in the very dry pine, juniper and alder litter. These latter two species are particularly large for Oribatida, being a millimetre or more in length and very shiny, yet this is the first record of these genera in eastern Canada. An undescribed species of *Tegeocranellus* in the carabodoid family Tectocepheidae, was discovered in the wet roots of sedges at the edge of the inner lagoon. This is the first record of this genus in Canada and there are no published records of this genus in North America.

Sandy beaches, sand bars and dunes are places to search for the dolichopodid fly, *Asyndetus ammophilus* Lw., which was found in Canada for the first time in the Park survey. An undescribed species of Muscidae (genus *Lispe*) and one of Empididae (genus *Chersodromia*) were also found on the sands. Sandbars yielded representatives of four hymenopterous families, namely, Diapriidae (genus *Paramesius*), Scelionidae (genera *Trimorus* and *Telenomus*), Aphidiidae (genus *Ephedrus*), and Ichneumonidae (genus *Olesicampe*). The crab spider *Ebo pepinensis* Gertsch, which is apparently restricted to sand dunes and is otherwise known from the east coast only from Sable Island and Kouchibouquac National Park, was found at Petit Etang and South Harbour. Dunes at South Harbour also yielded specimens of the showy jumping spider *Habronattus waughi* Emerton.

Beds of kelp and other vegetative debris on beaches are the habitats for the hister beetle *Baeckmanniolus palmatus* (Say), the hydrophilid beetle *Cercyon litoralis* (Gyll.) and the predaceous rove beetles *Cafius bistriatus* Er. *Aleochara maritima* Csy. and *Ocypus ater* Grav.; the last-named beetle is an introduction to the New World. Diapriid wasps (*Ismarus rugulosus* Foerst. -- the first Nova Scotian record, and the genus *Trichopria*) and a wingless cynipoid wasp (genus *Kleidotoma*) were interesting finds in these habitats.

Vegetated beaches yielded collections of the silvery blue butterfly, *Glaucopsyche lygdamus* Doubleday, which breeds on coastal legumes, and of the chinch bug *Cymus luridus* Stal. The latter is common in seed heads of sedges and rushes, the seeds of which it resembles. Two chalcidoid wasps were found on beach grasses, namely, *Eurytoma* sp. and *Harmolita* sp.

Salt marshes

Salt marshes and the margins of brackish inlets yielded collections of the marsh beetle *Cyphon variabilis* Thunb., the hydrophilid beetles *Anacaena limbata* F., *Enochrus hamiltoni* (Horn), and *Cymbiodyta vindicata* Fall., and the rove beetles *Stenus* (5 or more species), *Lathrobium* (several species), *Geodromicus* sp., *Philothus* sp., and *Euaestheticus* sp. The widespread wolf spider *Pardosa fuscula* (Thorell), common to both salt and fresh marshes, was found running over emergent vegetation.

Coastal scrub and headlands

Heath-covered headlands are home to the crowberry blue butterfly, *Lycaeides idas empetri* (Freeman), which breeds on heath plants.

The buffaloberry and crowberry scrub in coastal areas and the rocky barrens harbour two very interesting species of oribatid mites. A new species of *Licnodamaeus* in the superfamily Gymnodamaeoidea is an exciting find as this is the first record of this genus in eastern N. America. Prior to this, the genus was only known from dry habitats in the Coastal Range in California. The other interesting record is a new species of *Unduloribates* in the family Unduloribatidae, superfamily Oribatelloidea, which is the dominant large oribatid in these habitats. This genus is known from the Himalayas, and alpine areas in the Soviet Union. This is the first record of the family from Canada, and there are no published records of this family in North America; although specimens of the same species have been collected in the Catskill Mountains of New York.

Floodplains

The floodplain at the mouth of the Cheticamp River was rich in new species and in new records for the region, particularly in the Order Hymenoptera. The family Diapriidae was represented by *Belyta longicollis* Fouts and *Trichopria pezomachoides* Ashm., neither of which has been recorded before in Canada; in addition, there were representatives of six other genera and at least one new species. The family Scelionidae was represented by undescribed species in the genera *Tiphodytes* and *Trimorus*, by the first Canadian record of *Telenomus longicornis* Ashm., and by the first Nova Scotian record of *Tiphodytes gerriphagus* (March.). The family Platygastridae was represented by *Trichacis virginiensis* Ashm. and *Isocybus canadensis* Prov., and by unknown species in the genera *Platygaster*, *Allotropa*, *Amblyaspis*, and *Inostemma*. The birch leaf miner, *Fenusa pusilla* (Lepeletier), was abundant in this habitat.

Part IV. Identification of special habitats

Introduction

During the course of the Park survey, several habitats emerged as being particularly rich in rare and unusual species. Some of these species represent new records for Atlantic Canada and some are new for Canada. A discussion of the deciduous forest habitat at Lone Shieling, which could equally well have been included here, is given in Part V in the discussion of the significance of the Park fauna. One of the habitats discussed below is not in the Park so consideration should be given to ensure that the habitat is protected. Discussions of the four special habitats follows.

Bogs and fens

by K.G.A. Hamilton

Bogs and fens in the Park are diverse in physiography. Each one sampled had a different faunal composition, and some contained interesting or unique species not found in adjacent areas. While species-poor in Coleoptera and Lepidoptera, leafhoppers and flies were well represented and had many interesting records. In particular the fens along the old highway over North Mountain contained disjunct populations of high boreal species, including 4 Syrphids, 2 Dolichopodids and 1 Scathophagid along with 2 Muscid flies that were previously known only from Europe. The Paquets Lake bog supported many interesting leafhopper species, including 2 disjunct species from Pennsylvania and westwards, and 2 unique and undescribed species. Another undescribed leafhopper occurred in both Paquets Lake and North Mountain bogs that is known to occur from northwestern Québec to Saskatchewan.

Unfortunately, the number of bogs and fens sampled was rather small considering the diversity of faunal elements encountered. Further sampling in other areas will undoubtably turn up additional interesting records.

Fig. 22. The largest grassy fen near the road across North Mountain is the site where the greatest number of high boreal species were encountered in the Park.

Stream margins

by J.M. Campbell and V.M. Behan-Pelletier

There is a considerable diversity of stream-related habitats in the Park. One such habitat containing a broad diversity of species, particularly beetles, is the banks of streams and rivers near the edge of the water. This habitat may be subdivided in two ways: (1) type of substrata or (2) distance from water (moisture).

In the Park, there are four types of substrata on the stream margins (1) Sand, characterized by the presence of the ground beetles *Omophron americanum* Dejean, *O. tesselatum* Say and *Dyschirius sphaericollis* Say and the rove beetles *Bledius* (2 species), *Carpelimus* (4 species), and *Thinobius* (1 species). (2) Gravel banks, characterized by the presence of *Bembidion chalceum* Dejean, *B. planatum* LeC., *B. rusticum* Csy., *B. carolinense* Csy., *B. nigrum* Say, *B. salebratum* LeC., *B. transversale* Dejean, *Elaphropus tripunctatus* Say and *Apristus subsulcatus* Dejean and the rove beetles *Microedus austinianus* LeC., and *Stenus* (4 or 5 species). (3) Stone beaches where the rocks are considerably larger than gravel, characterized by the ground beetles *Diplous rugicollis* Randall and *Platynus tenuicolle* LeC. and the rove beetle *Psephidonus strictus* Fauvel. (4) Beaches with moss covered rocks and wet leaf litter characterized by the rove beetle *Brathinus nitidus* LeC.

Fig. 23. Rocky second order stream at Lone Shieling

The composition of the beetle fauna also varies depending on distance from the stream edge. Species such as the rove beetles *Microedus austinianus* and *Psephidonus strictus* are found immediately at the edge of the water. Leaving the water there is a progression of *Bembidion* species and *Stenus* species until eventually a habitat is reached that can no longer be considered stream side.

In addition to the factors described above, a number of features are required to support a permanent colony. First, the stream side habitat must be high enough to provide refuge for the larvae during midseason floods; the stream should have enough drop that, during floods, the edges do not cover all of the available stream side habitat; and the stream must be relatively free of sediment to prevent filling of all the interstices making the beach totally unsuitable as a habitat.

Two oribatid mite species in the family Ceratozetidae, *Sphaerozetes arcticus* Hammer and *Melanocetes longisetosus* Hammer, previously known only from arctic and subarctic regions of North America and eastern U.S.S.R. were found on stream margins in the Park. In the arctic and subarctic these species prefer moist to wet habitats, e.g. moist moss and decomposing leaves in tussock tundra, but not necessarily flowing water. In the Park, they were found only in wet moss on rocks at the edge of swiftly flowing, narrow, shaded streams. This distribution suggests that the species are limited by temperature.

Additional research is needed on the distribution of all the species found in this habitat. Evidence from the mites and the rove beetles suggests that, at least in certain cool, stream-side habitats, it is possible for some arctic or subarctic adapted species to survive. Unfortunately, the total distribution of most of the species of beetles found in this habitat are unknown and no further generalization is possible.

Coastal habitats

by J.M. Campbell

Coastal areas of the Park are the most heavily used, however, few visitors are aware of the diversity of coastal habitats, their fragility, or of the rich arthropod fauna restricted to each of these coastal niches.

None of the habitats discussed above by Dondale is uniform and all vary as does the resident arthropod fauna. This is particularly evident between the fauna of the eastern coast of the Park and that of the west coast. The habitats are strongly influenced by factors such as tidal differences, protection from storms, size of the habitat, etc. In addition, each of these habitats is rather small in size and usually isolated into "pockets", which may be separated from other similar habitats by many kilometers.

The fragility of these habitats is influenced by a number of factors. Small isolated pockets of habitat, such as sandy beaches, rarely have many species of resident arthropods because the fauna is likely to be destroyed by unusually high tides or by inundation during storms. Factors such as size of a beach, slope of a beach to allow arthropods to retreat above high water, degree of isolation from other similar habitats to allow for repopulation, and protection from storms, all play major roles in the species composition of the habitat.

Of even more importance is the influence of man on coastal habitats. These habitats are the areas most often selected for building sites, parking lots, picnic grounds, swimming areas, and vehicle access lanes. These uses and activities should be closely monitored in Natioanl Parks to ensure the continued existence of the species restricted to these fragile areas. It is important that these fragile and biologically significant habitats are protected in the Park since similar habitats outside the Park are being rapidly destroyed by development or overuse. Further damage to coastal habitats in the Park should be prevented. The unique fauna associated with piles of rotting seaweed are found in only a few places in the Park, especially near the Cheticamp end of the Park. The practice of harvesting seaweed in the Park should be prohibited because the habitat is so scarce within the Park.

All of the coastal habitats described above by Dondale, except for headlands and scrub, are subject to serious damage or even biological destruction by oil spills.

It should again be emphasized that coastal habitats are unique and biologically interesting. Since many of the species associated with coastal habitats are restricted to them, studies of their zoogeography can often give insights into the previous history of the habitats. Lindroth (1957), for example, argued that the hydrophilid beetle, *Cercyon litoralis* (Gyll.) was introduced into North America from Europe. Smetana (1978) showed that based on fossil evidence, the species was present on the Magdalen Islands at least 38,000 years ago and the more likely explanation for the distribution pattern is that the species is native to North America and subsequently reached Europe by the Gulf Stream. The rove beetle genus *Cafius* is found on sandy beaches over most of the world. Yet, to date, no phylogenetic analysis has been made of the genus, which could shed light on factors such as dispersal routes, ocean currents, continental movements, etc.

Of equal interest are the physiological adaptations required by species to live in brackish or saline habitats. Again, these coastal habitats can serve as a laboratory to study such biological factors as: how an insect physiologically eliminates excessive salt, how species adapt to environments that are either excessively arid or humid, how species survive periodic inundations by salt water, etc.

Although the arthropod fauna of the coastal habitats are depauperate, they are no less interesting. Because their distribution in the Park is so spotty, every effort should be made to preserve these areas.

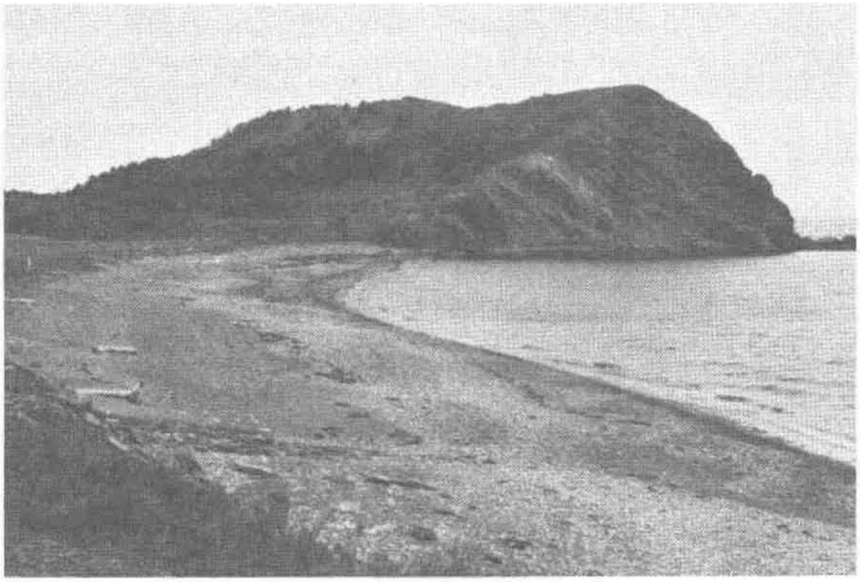


Fig. 24. Beach habitat at Presqu'île

Gypsum cliffs

by K.G.A. Hamilton

The lowlands of the Aspey River between Cape North Village and Dingwall lie outside the Park boundaries. They deserve comment, however, as this area has several unique features that make for special biological interest. In particular the gypsum cliffs that dominate the area influence the environment significantly as the groundwater there is basic rather than acidic. Consequently, the marshes have rather different faunas than those within the Park boundaries. Two leafhoppers, *Limotettix parallelus* (Van Duzee) and *Macrosteles bifurcata* Beirne are found there although the next most easterly records for both are from western Québec. Other leafhoppers of interest are found in the surrounding woods and fields, which are climatically temperate-zone, like Lone Shieling, but very different in faunal composition. Of the 27 leafhopper species known from Cape Breton Island that are not found in the Park, 12 are found in adjacent areas and 10 of these are found only in the Gypsum cliff-Aspey River lowland area. One of these is an undescribed species known only from this habitat.

PART V SIGNIFICANCE OF THE PARK FAUNA

Introduction

by J.D. Lafontaine

Cape Breton Highlands, like other National Parks, sets aside characteristic portions of the Canadian biota for protection and preservation. The rich variety of habitats in Cape Breton Highlands National Park not only serve to protect the arthropod fauna characteristic of these habitats, but also many rare and unusual species whose presence in the Park could never be detected except by intensive, highly specialized collecting techniques.

The unique location of Cape Breton Highlands, however, extends the significance of the Park beyond the role of preservation of Canadian habitats. The Park is significant for zoogeographic studies for several reasons. First, the Park is located on an island at the end of a long peninsula. As a result, a filter bridge effect could be expected where the range of only a portion of the boreal forest fauna of central Canada would be expected to reach the Park. Second, the Park is at the northernmost limit of the Acadian deciduous forest zone. Third, the habitats of the Park, and its physical location, are between Newfoundland and mainland Nova Scotia and this could be expected to have an influence on the composition of the fauna. Finally, the Park is adjacent to the area of the former Gulf of St. Lawrence glacial refugium so the Park could be expected to harbor relict and disjunct populations of some species.

The influence of these factors on selected groups of arthropods is discussed below.

Zoogeographic affinities of the Syrphinae (Diptera) of Cape Breton Highlands National Park

by J.R. Vockeroth

The three areas of temperate eastern Canada in which the Syrphidae have been most thoroughly collected are the Ottawa district (a 50 km. radius from the Peace Tower - 2827.4 sq. km.), Cape Breton Highlands National Park (950.5 sq. km.) and Kouchibouquac National park (225.3 sq. km.). The species of the subfamily Syrphinae of the three areas are compared here in terms of their Holarctic-Nearctic, east-west, and north-south distribution.

The species are divided into two groups on a Holarctic-Nearctic basis.

(1) Holarctic, occurring on both sides of Bering Strait (Maps 1-7, 9-11, 15).

(2) Nearctic, occurring only on the American side of Bering Strait (Maps 8, 12-14, 16).

The species are also divided into two groups on the basis of east-west distribution.

(1) Transcontinental, occurring from west of the Rocky Mountains eastward at least as far as the Ottawa district (Maps 1-7, 9-15).

(2) Eastern, occurring only east of the Rocky Mountains (Maps 8, 16).

Only very few species were difficult to assign to these categories. One is *Platycheirus jaerensis* Nielsen, known from Norway Bay in western Quebec, Labrador and Cape Breton Island. Although it is almost certainly transcontinental in North America it is treated here, on the basis of the known Nearctic distribution, as eastern.

A division on a north-south basis is more difficult. Three groups are recognized. Many species clearly belong to one of the three but a number of widespread species, some of which occur from the northern limit of trees (or even farther north) south to the southern United States or even Mexico or Central America have been assigned on the basis of the apparent zone of greatest abundance (Maps 11, 13, 15). The groups are:

(1) Boreal: most abundant in approximately the northern half of the forested area of Canada (Maps 1-6).

(2) Cool temperate: most abundant in approximately the southern half of the forested area of Canada (Maps 7-11).

(3) Warm temperate: most abundant in the United States and occurring, in Canada, primarily in the southern part (Maps 12-16).

The figures are:

Ottawa District 71 species

Holarctic	30 species	42.3%
Nearctic	41 species	57.7%
Transcontinental	57 species	80.3%
Eastern	14 species	19.7%
Boreal	4 species	5.6%
Cool temperate	50 species	70.4%
Warm temperate	17 species	24.0%

Cape Breton Highlands N.P. 55 species

Holarctic	30 species	63.6%
Nearctic	25 species	45.4%
Transcontinental	49 species	89.1%
Eastern	6 species	10.9%

Boreal	6 species	10.9%
Cool temperate	41 species	74.5%
Warm temperate	8 species	14.6%

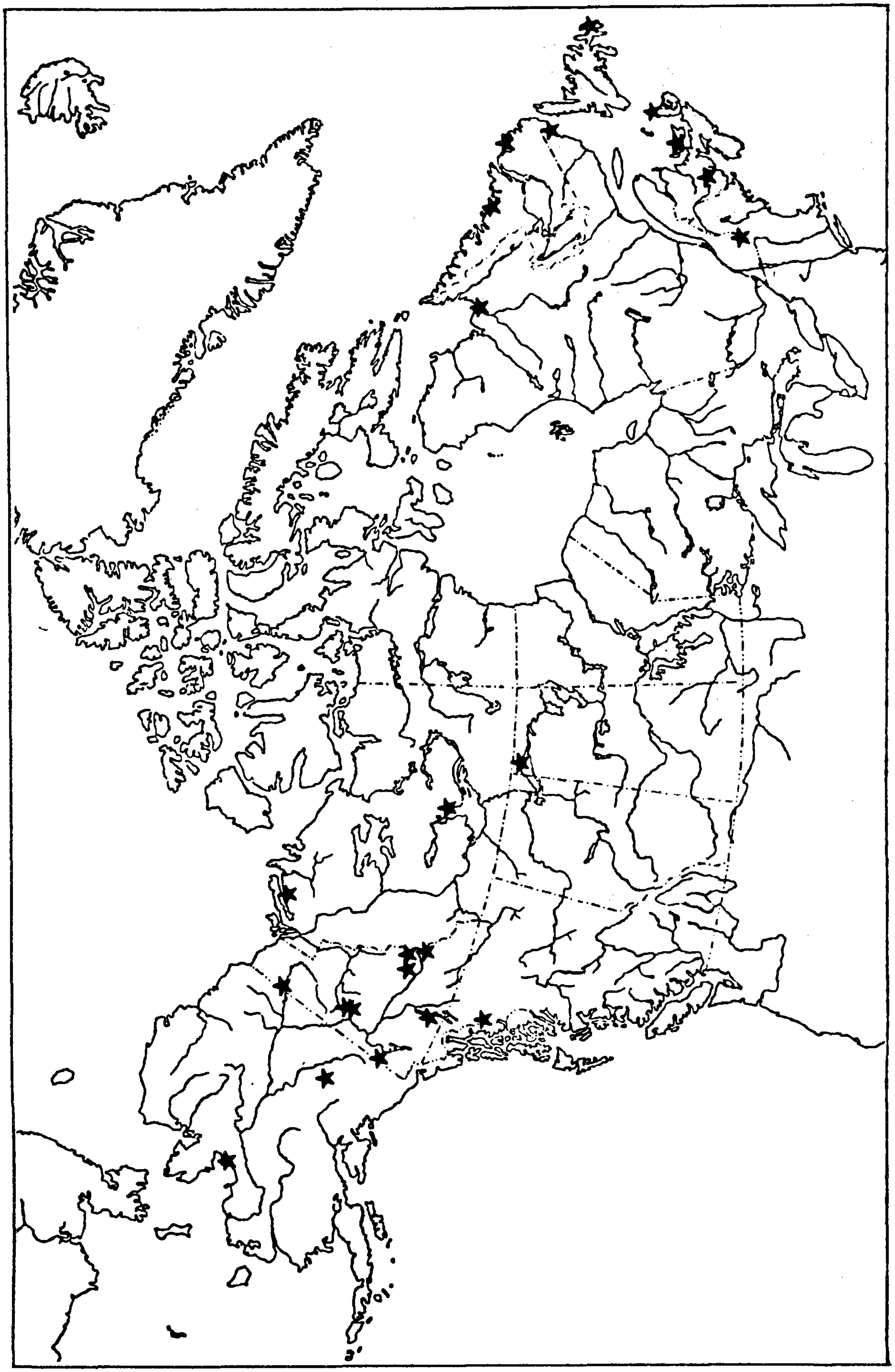
Kouchibouquac N.P. 47 species

Holarctic	19 species	40.4%
Nearctic	28 species	59.6%
Transcontinental	41 species	87.2%
Eastern	6 species	12.8%
Boreal	0	0%
Cool temperate	35 species	74.5%
Warm temperate	12 species	25.5%

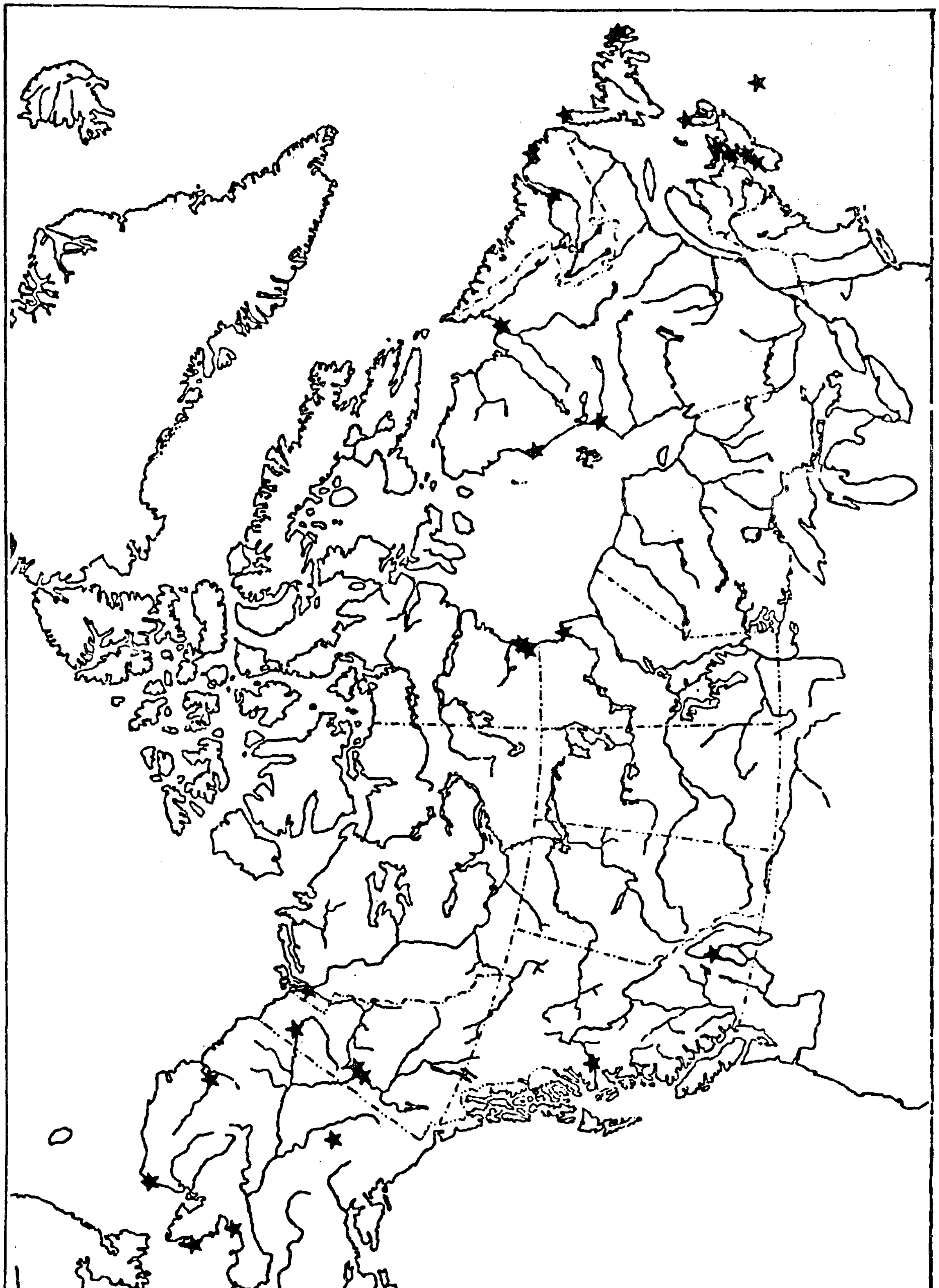
A few of the figures are unexpected. The Ottawa District has, as is to be expected, the largest number of species. However, the Syrphinae have been collected there for over sixty years, and the area is almost exactly three times the area of CBHNP, where collections were made only during two years. Moreover, only very few additional species can be expected from the Ottawa District, whereas at least seven additional species may occur in CBHNP. These seven are all known from Nova Scotia; two of them occur in Cape Breton Island, and one in Nova Scotia and Newfoundland. Ten additional species occur in New Brunswick or Prince Edward island, giving a total of 72 species for the three Maritime provinces. 161 species of Syrphinae are known from Canada; of these 101 occur east of Manitoba and south of 50°N latitude. This figure of 101 species is the largest number than can be reasonably expected in any of the three areas discussed here, although it is very unlikely that any of the three areas will have this many.

The highest proportion of transcontinental species in the easternmost of the areas is somewhat unexpected but is readily accounted for by the fact that CBHNP also had the highest percentage of boreal species, all of which are transcontinental. Four of the six boreal species were taken only in the bog on North Mountain (Maps 3-6), one in the French Lake bog and on an upland barren (Map 1), and the sixth, the least boreal of the group, at both high and low altitudes (Map 2).

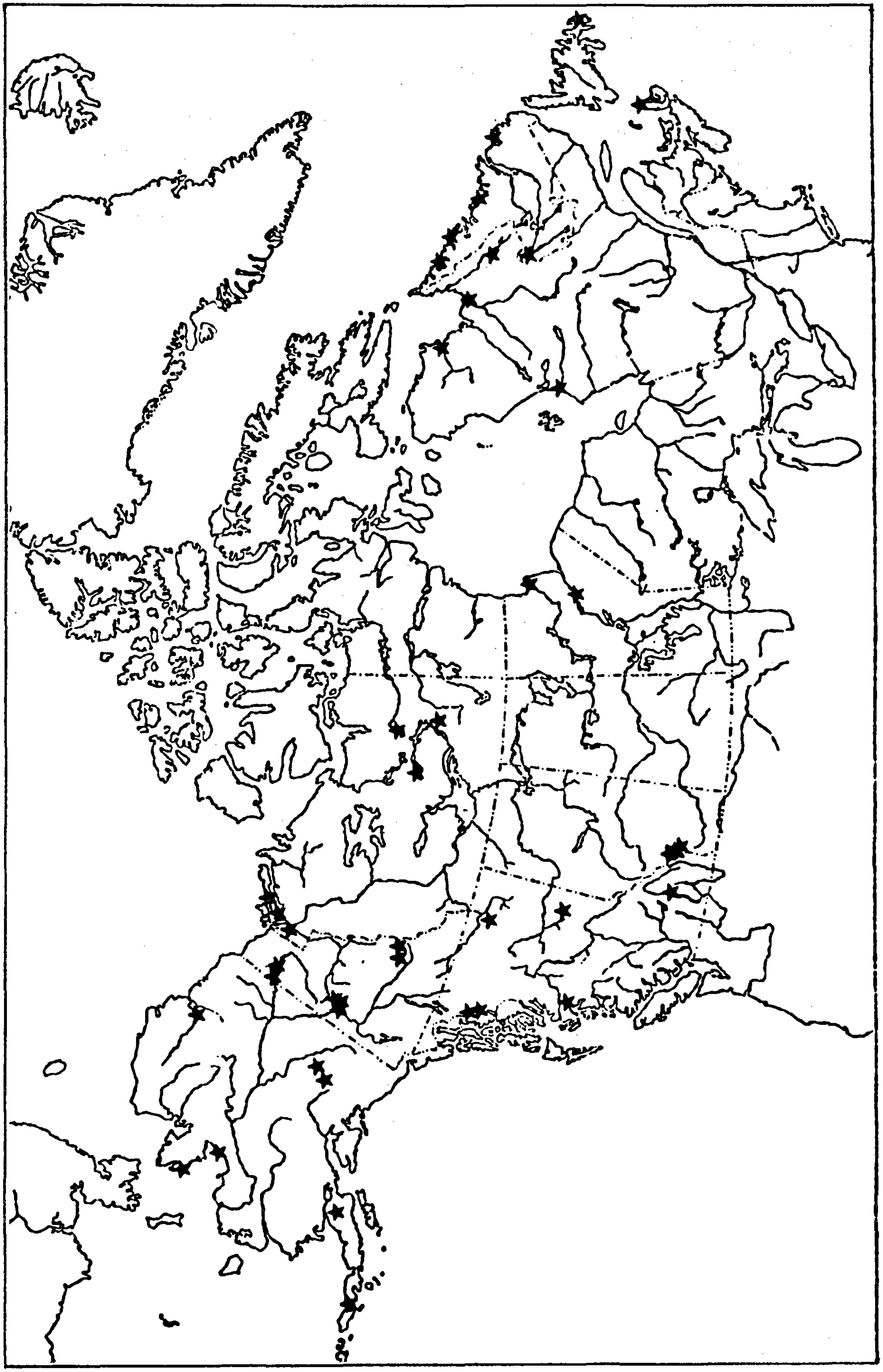
A surprising observation is that Kouchibouquac National Park, which lies more than 1° of latitude north of Ottawa, has a lower average growing-season temperature than Ottawa, and has very extensive sphagnum bogs, has no species of Syrphinae which can be considered boreal. Probably as a result of this the proportion of Holarctic species is the lowest of that of the three areas, and much lower than that of CBHNP.



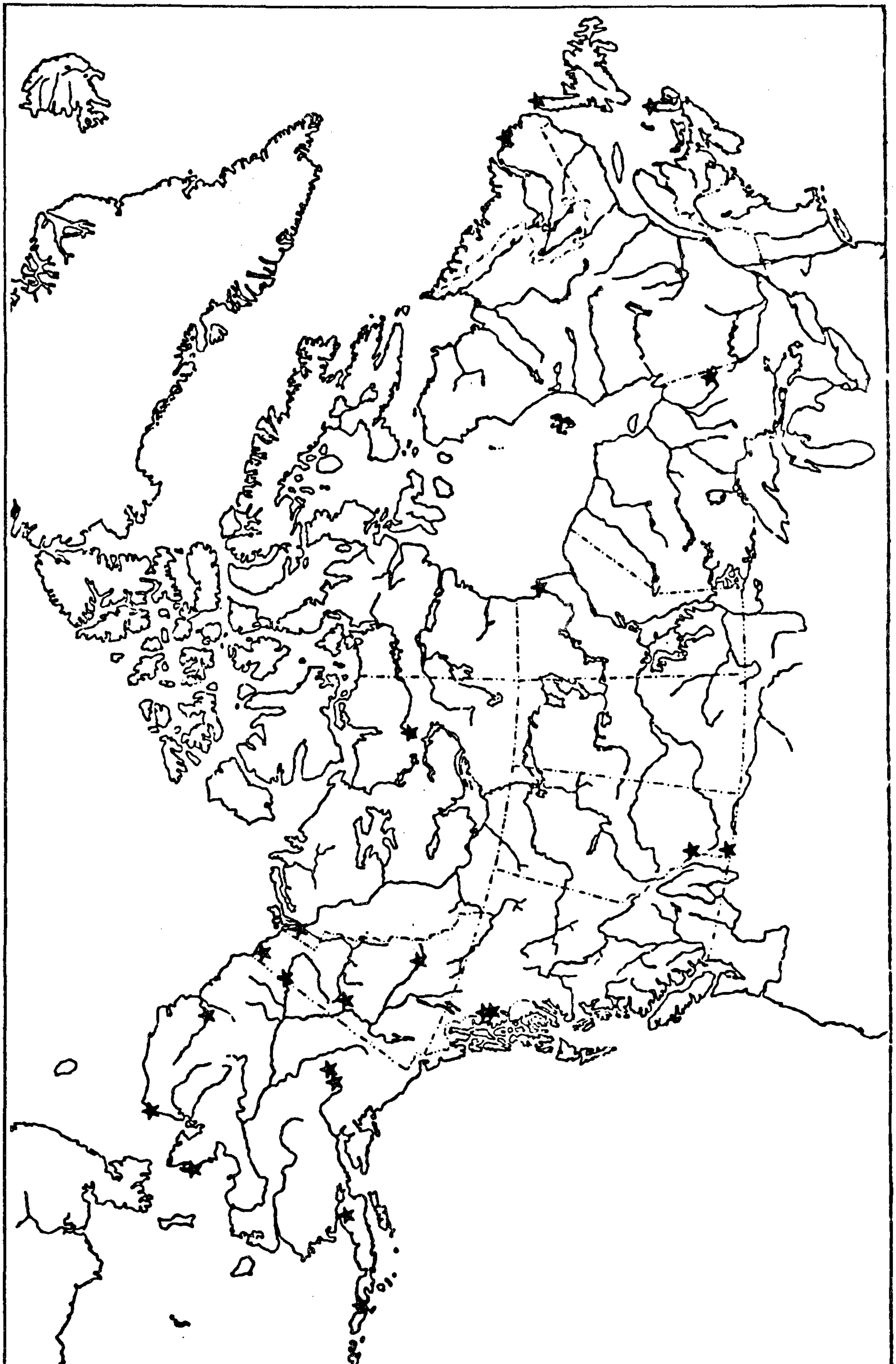
I Didea alneti (Fall.)



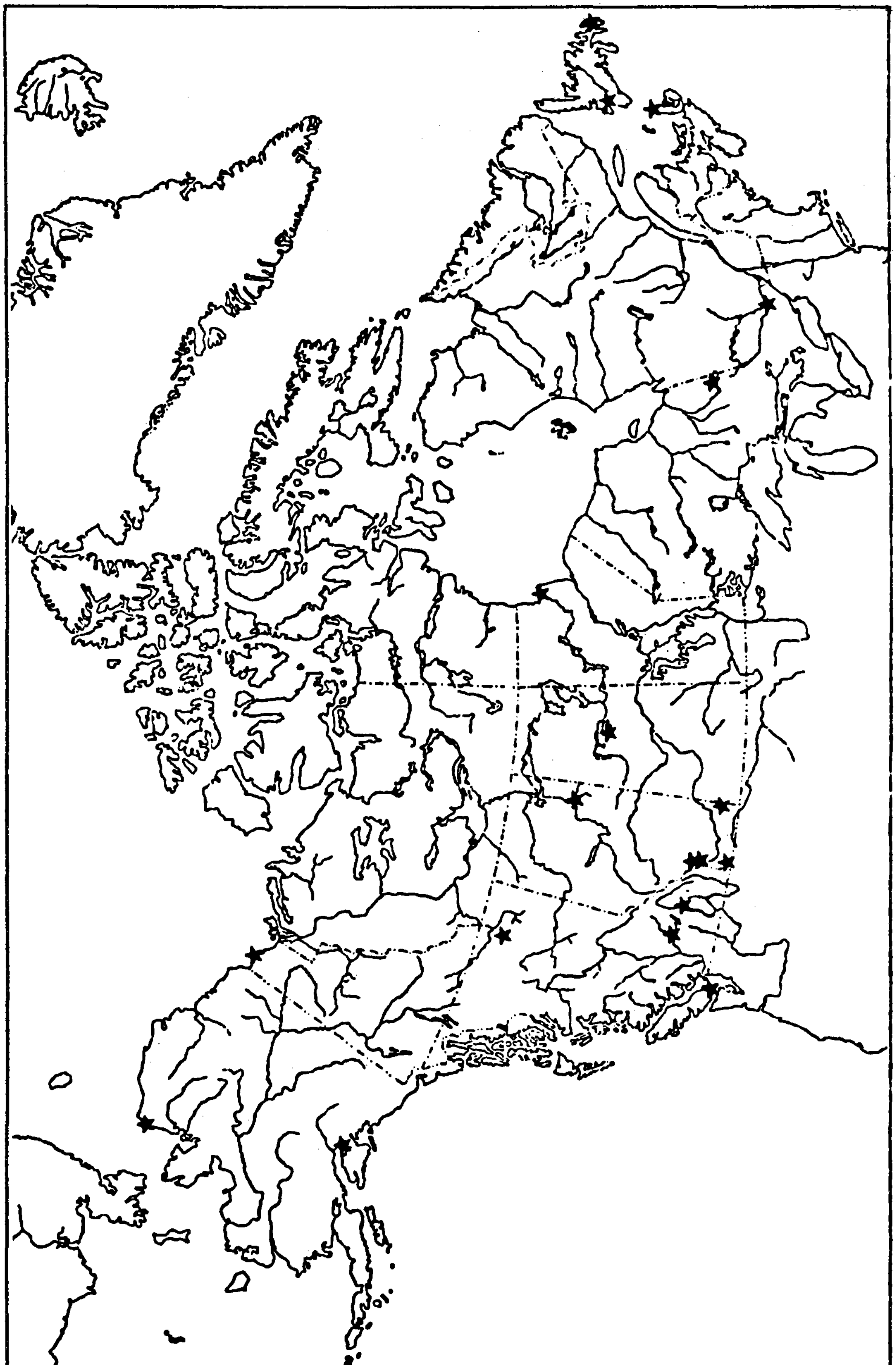
2 Platycheirus clypeatus (Mg.)



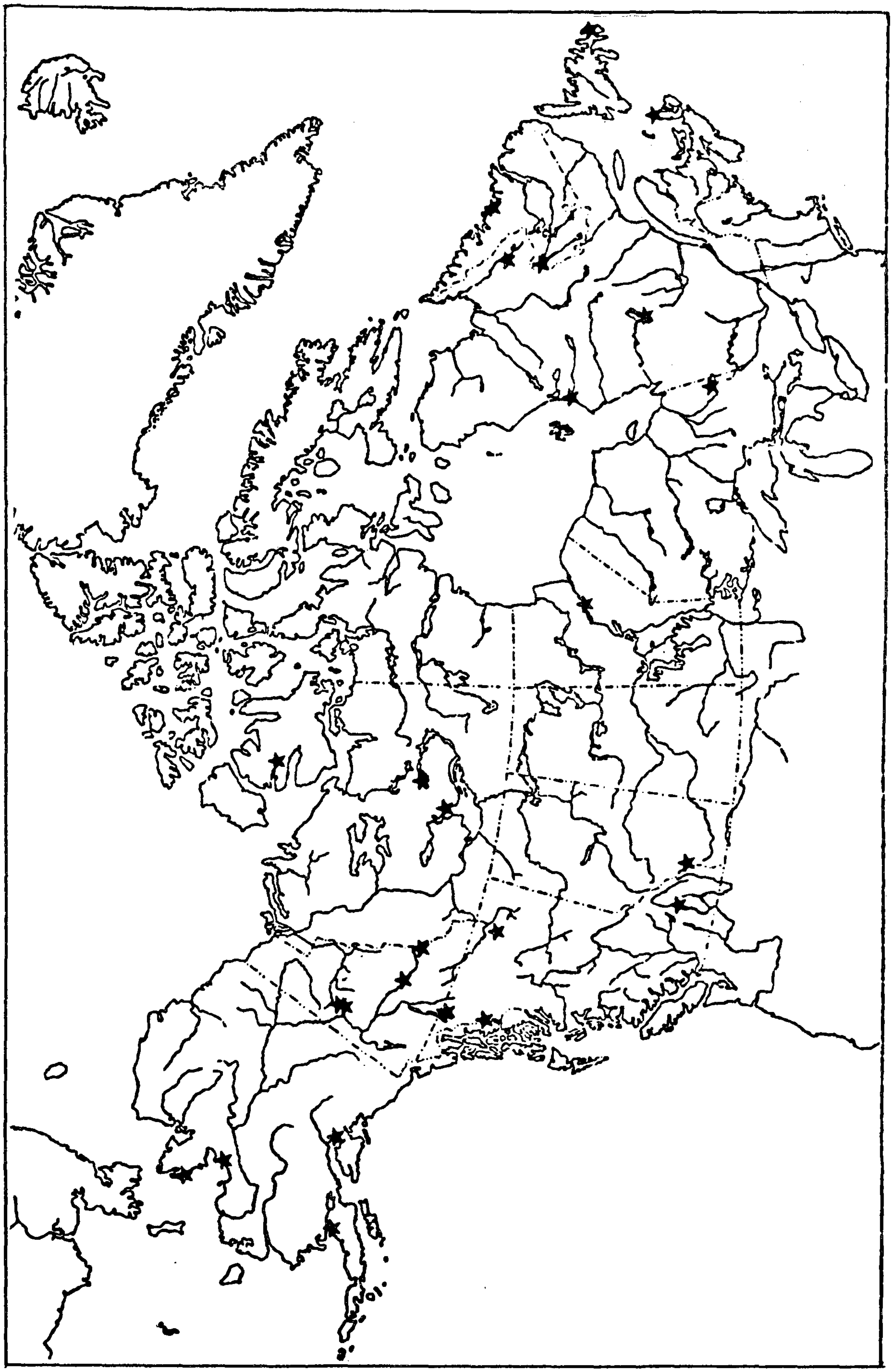
3 Platycheirus sp., n.name



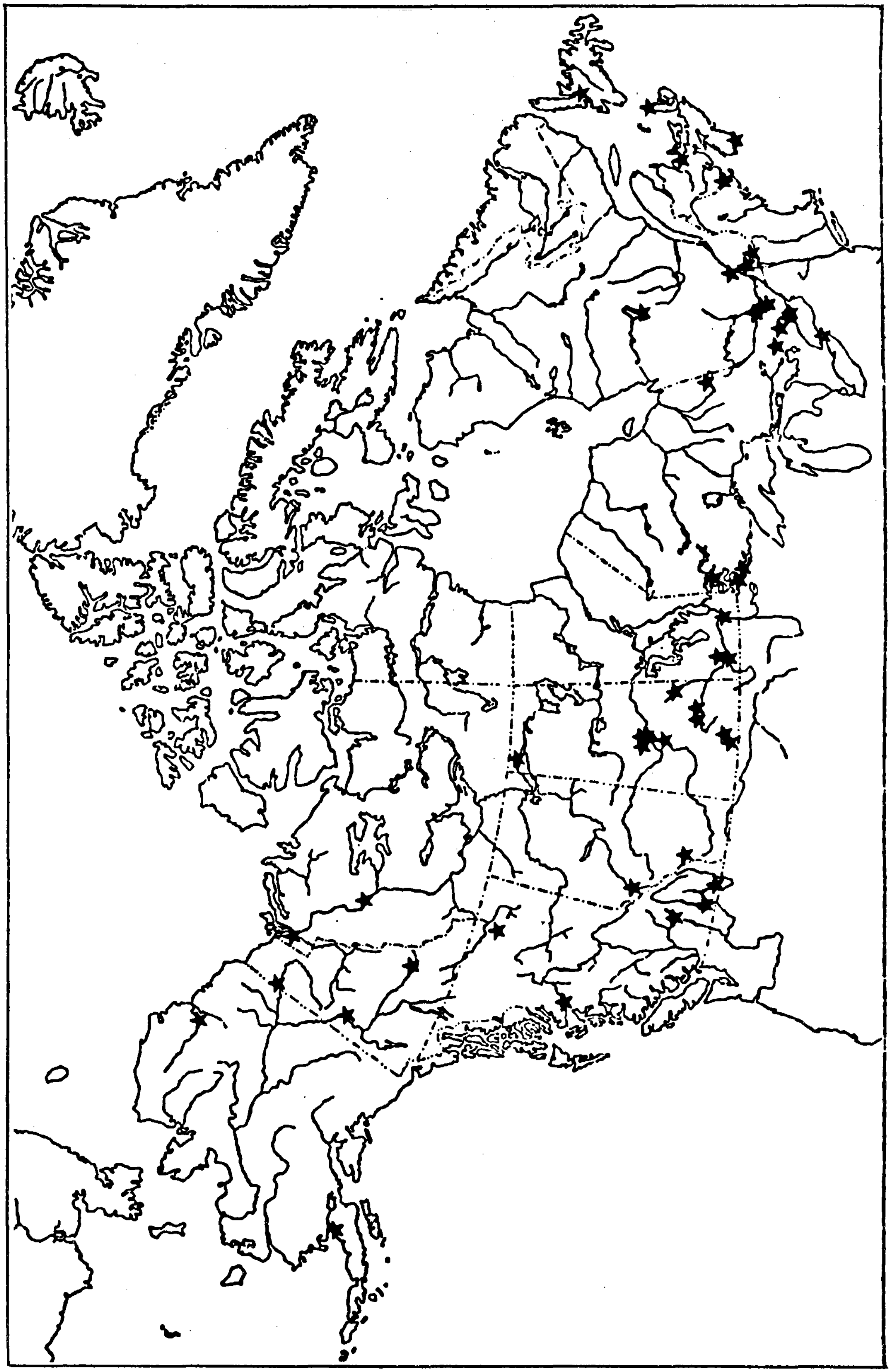
4 Platycheirus podagratus Zett.



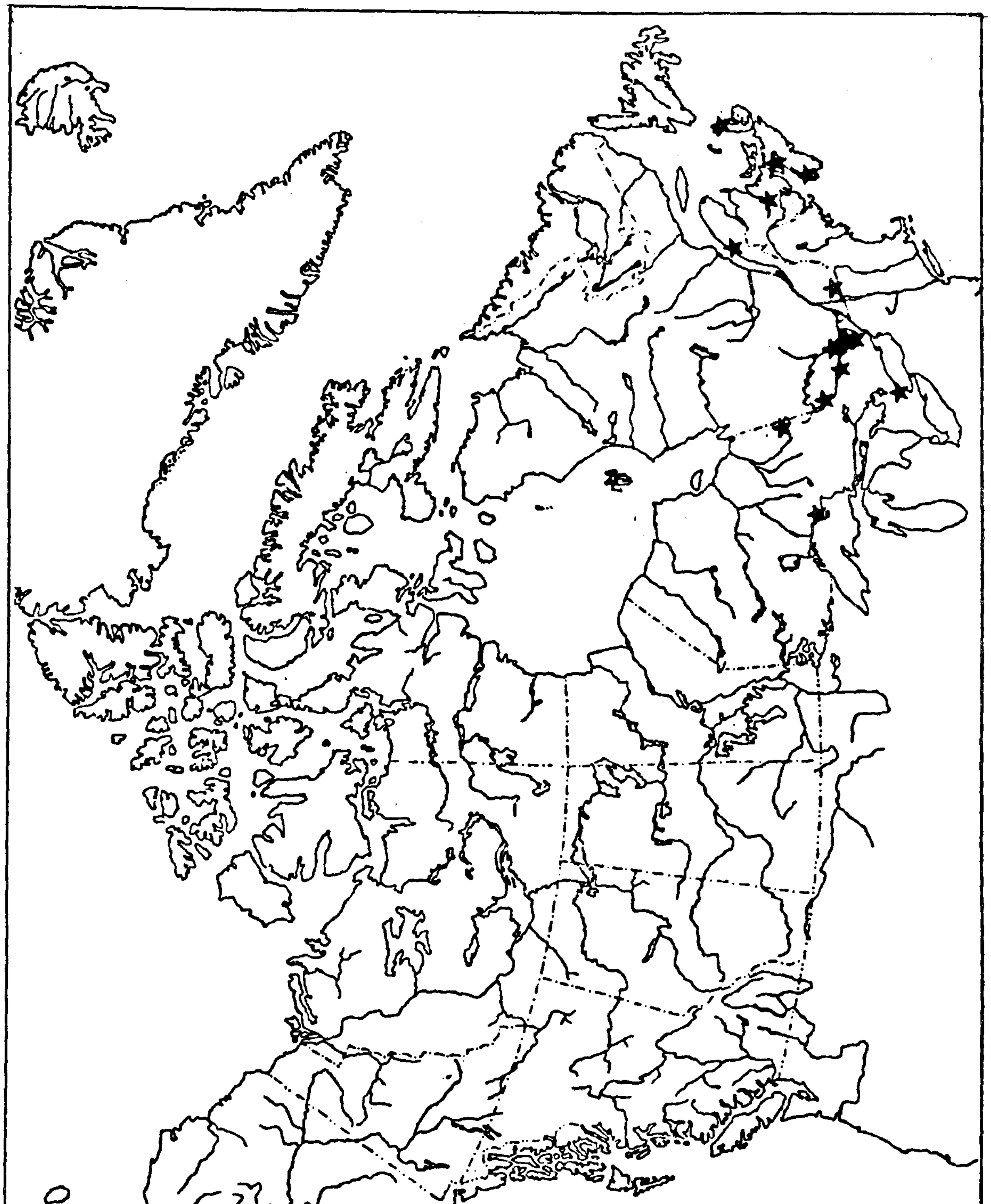
5 Platycheirus scutatus Mg.



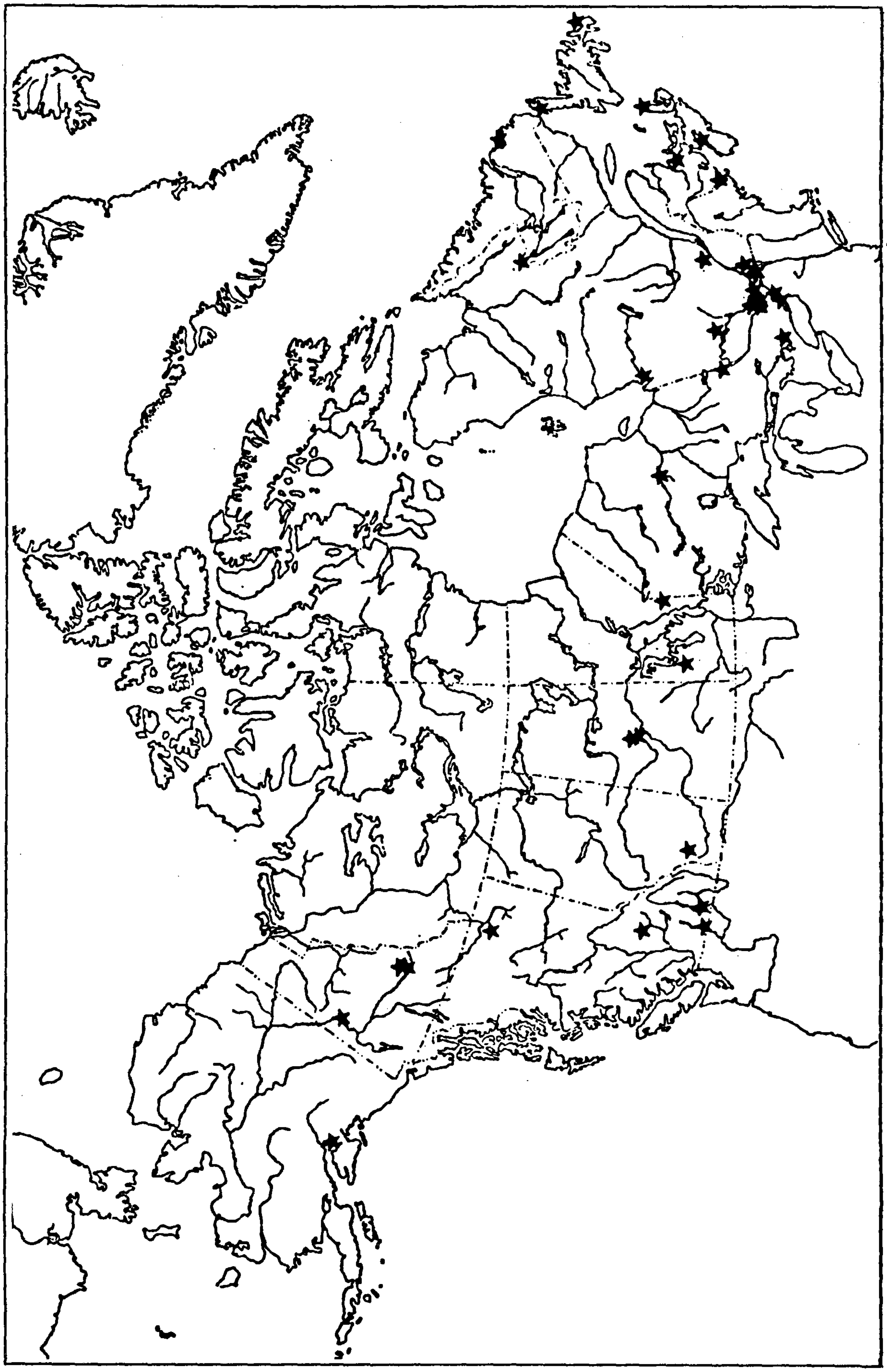
6 Platycheirus varipes Cn.



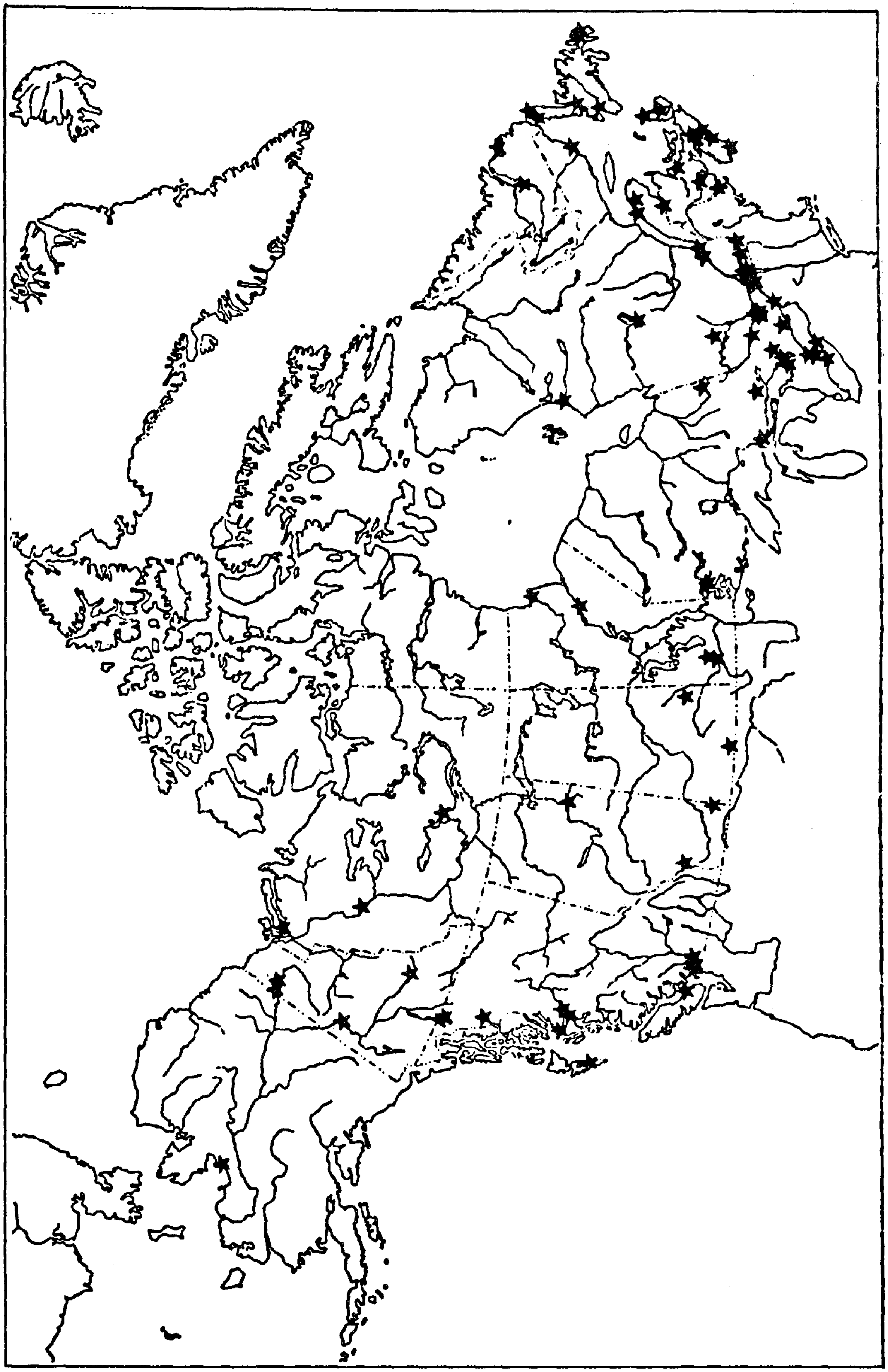
7 Platycheirus angustatus Zett.



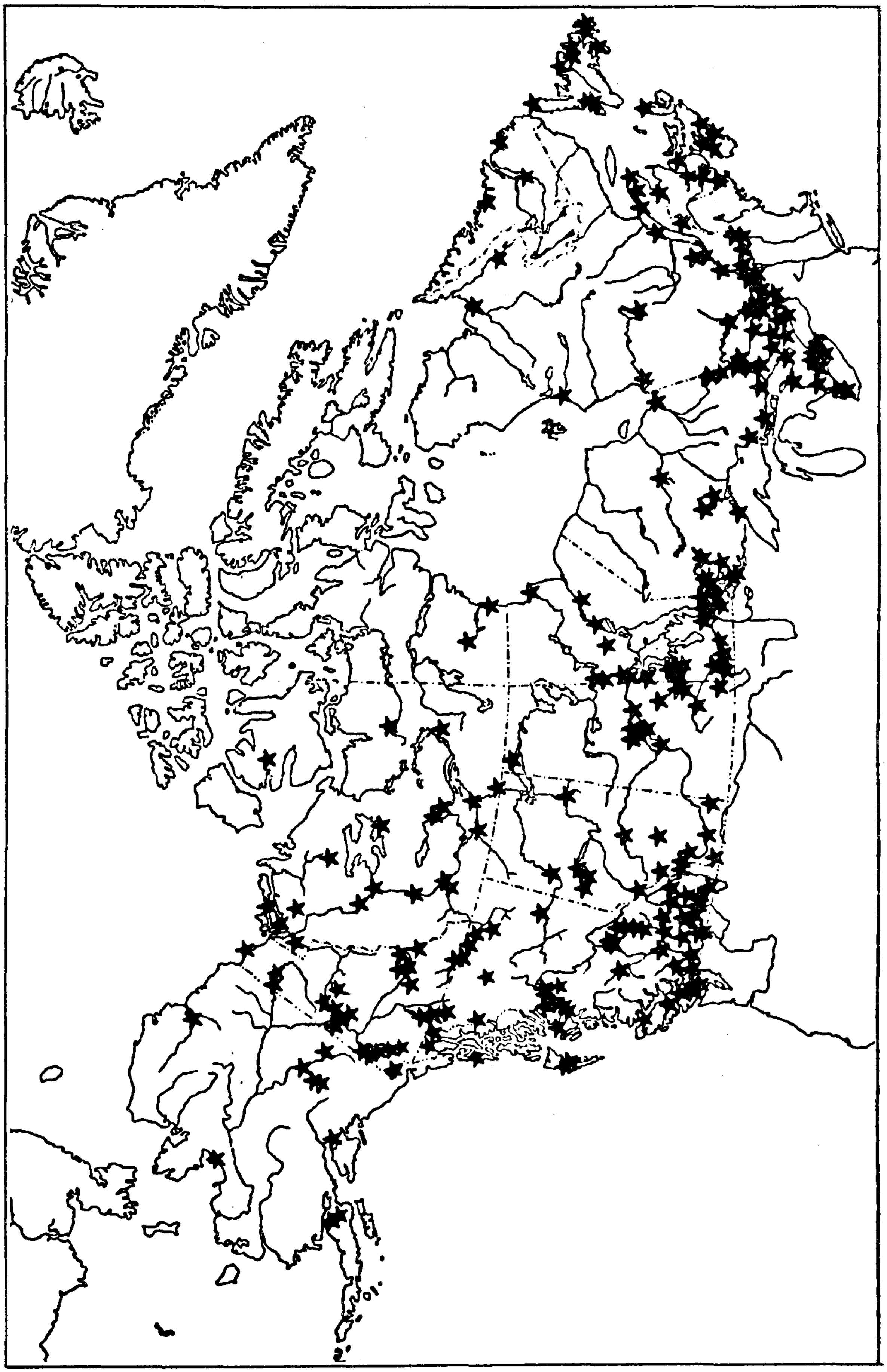
8 Platycheirus inversus Ide



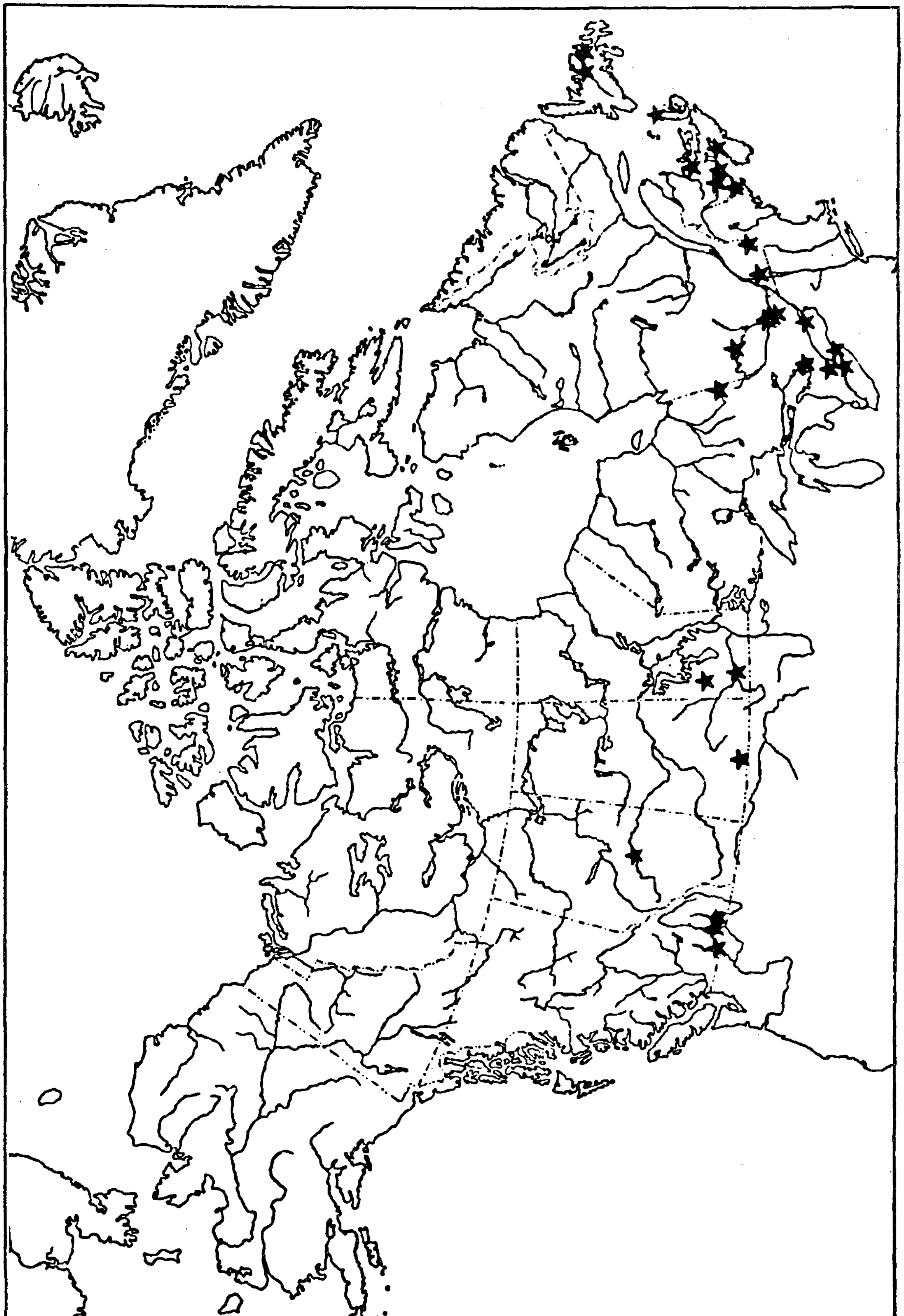
9 Platycheirus rosarum (Fab.)



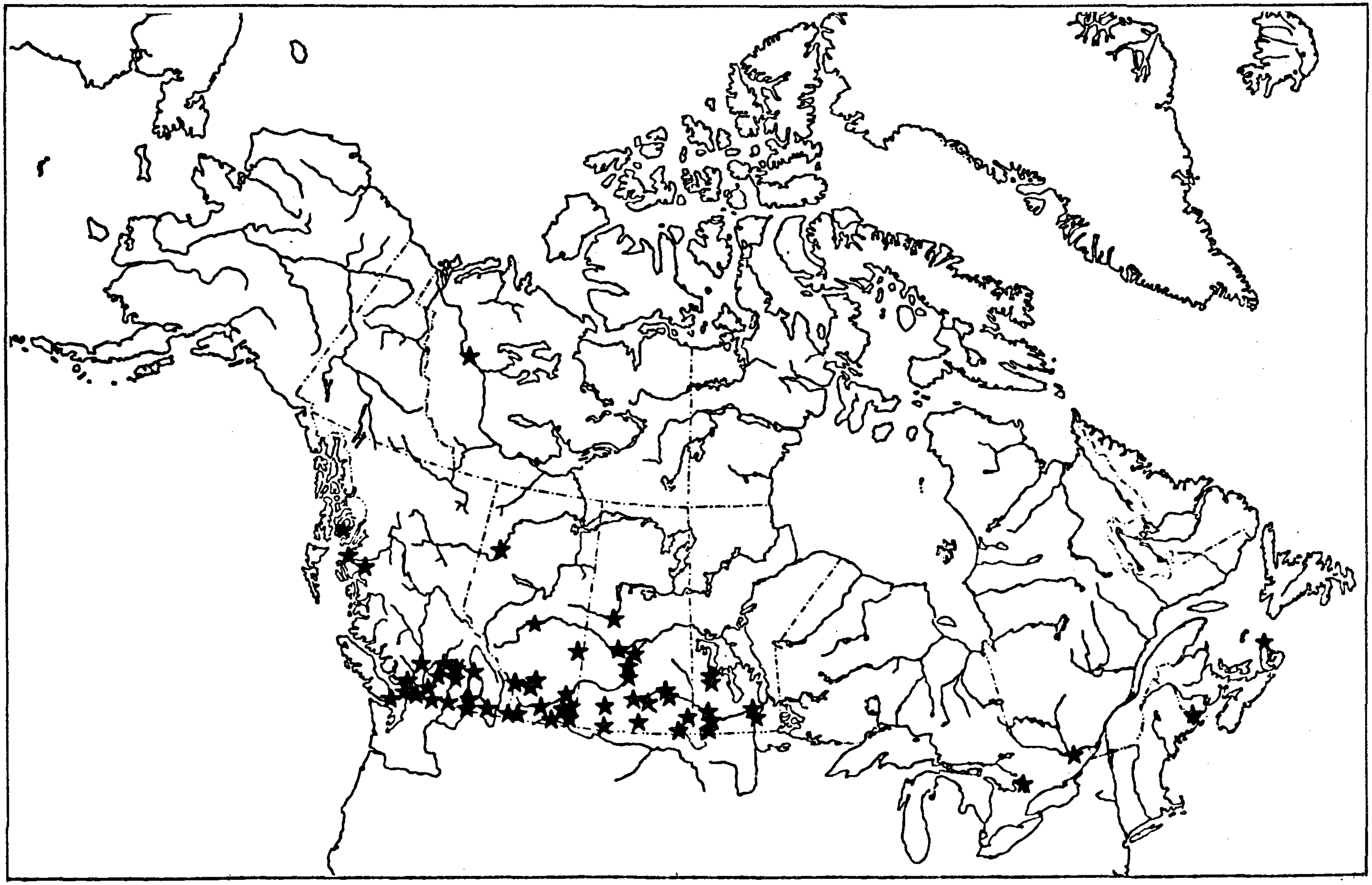
10 Platycheirus scambus Staeg.



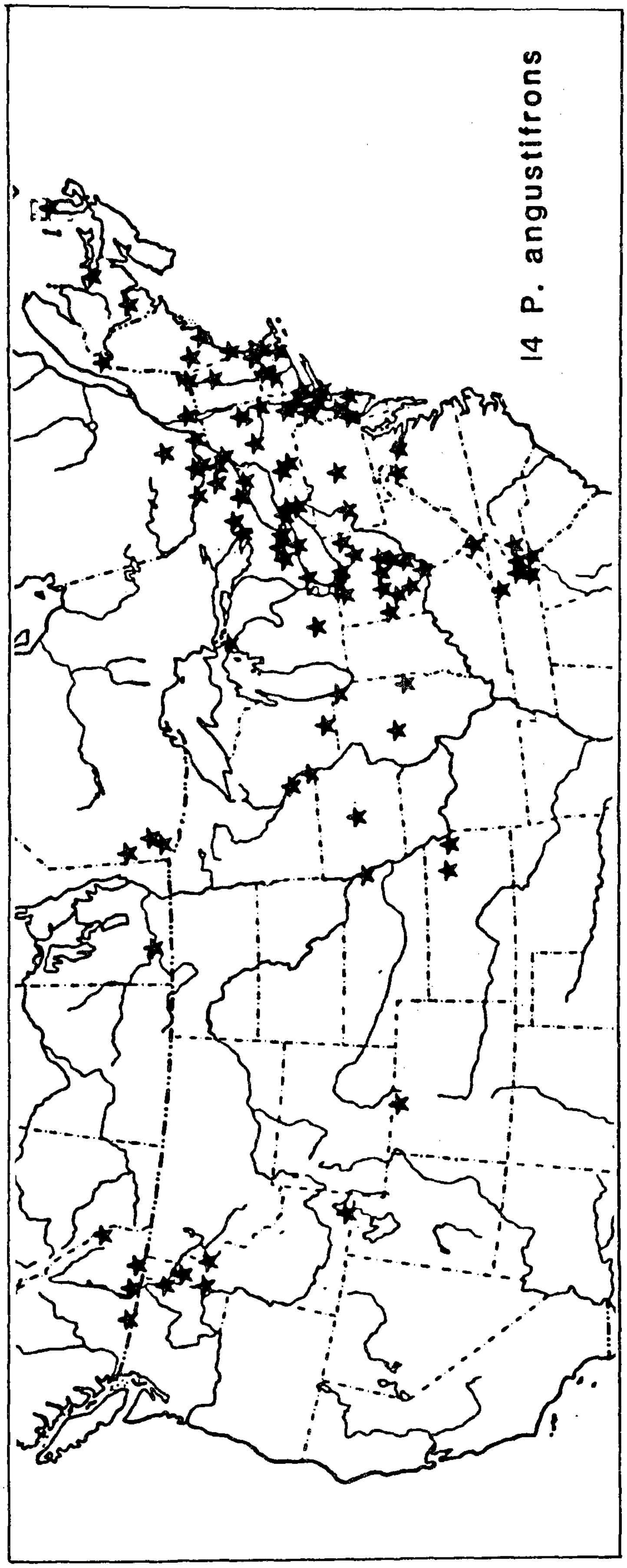
II Syrphus ribesii (L.)

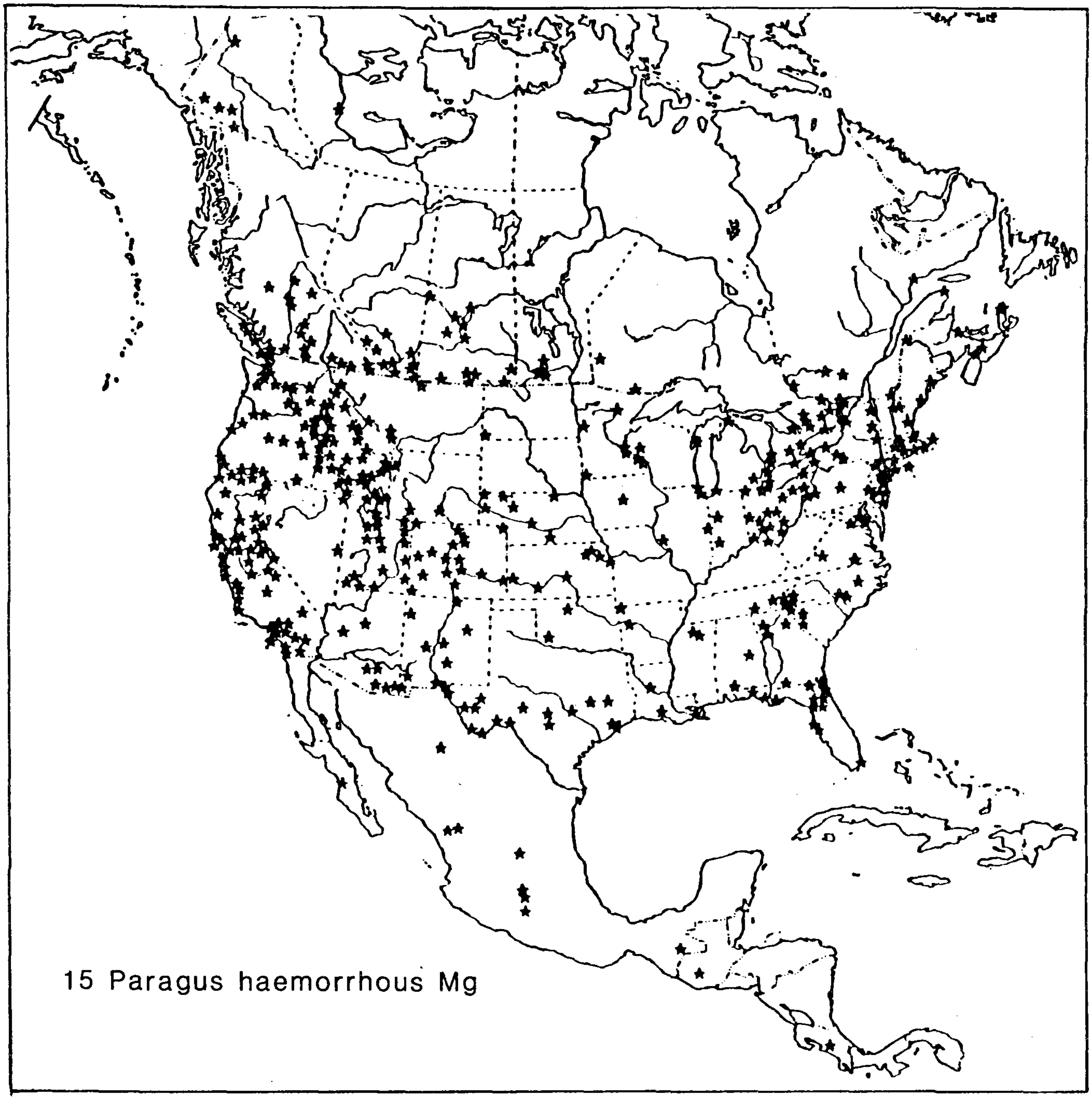


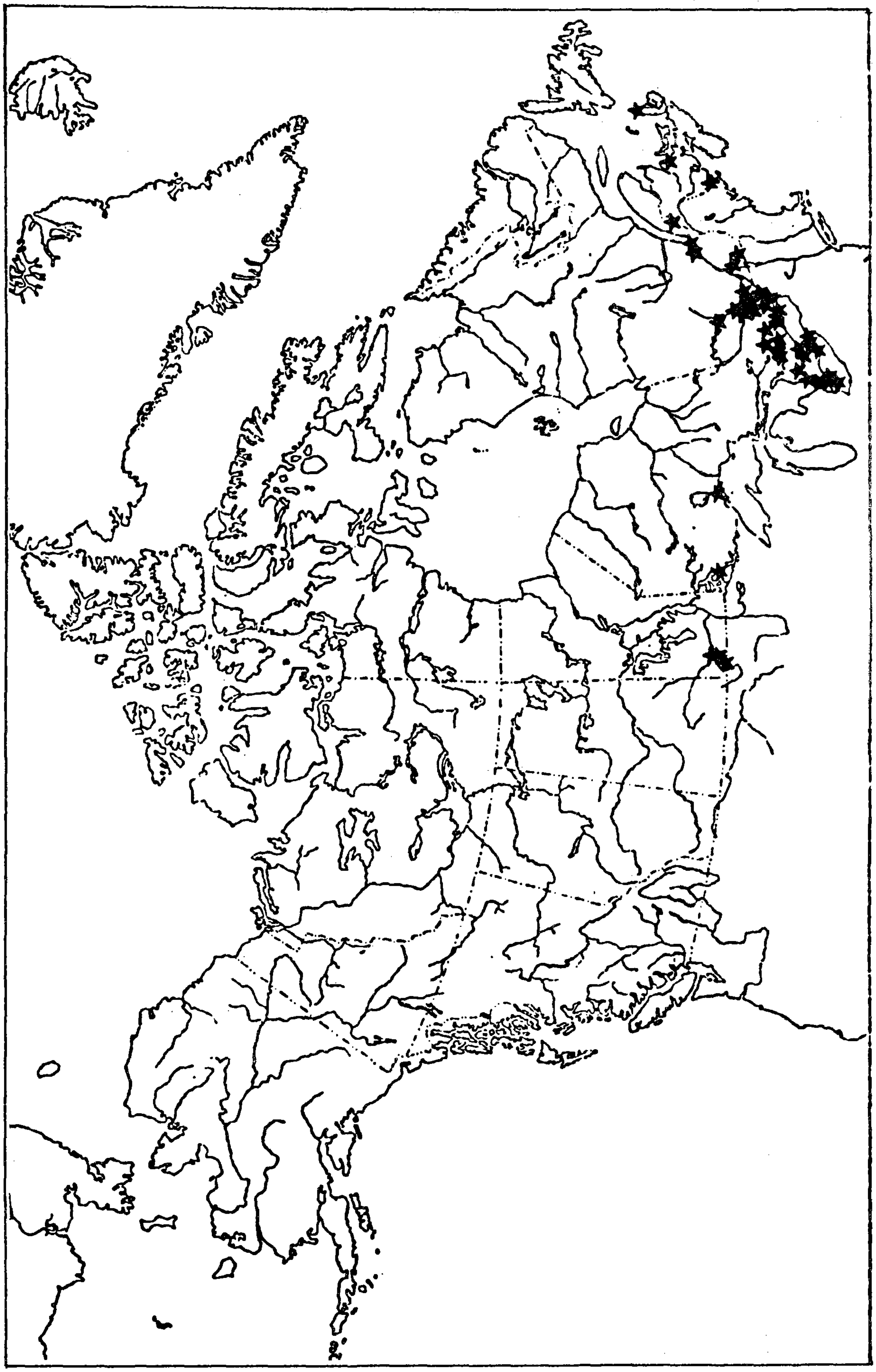
12 Epistrophe xanthostoma (Will.)



13 Eupeodes volucris O.S.


14 P. angustifrons


15 Paragus haemorrhous Mg



16 Toxomerus geminatus (Say)

Zoogeographic affinities of the actinedid mites of Cape Breton Highlands

by I.M. Smith

As expected, most of the species of actinedid mites collected in the Park are distributed throughout temperate eastern North America wherever suitable habitats are found. However, some representing new records for North America, are restricted to particular areas of eastern North America, or exhibit marked distributional disjunctions from conspecific populations or sister species elsewhere in North America. The specimens of the eriophyids *Keiferella piceae* Boczek and *Monochetus sulcatus* Nalepa, and the rutripalpid *Rutripalpus* sp. (near *R. limicola* Sokolow), represent the first nearctic records of these genera which were previously known only from Europe. The Cape Breton populations of the aturid *Diamphidaxona* sp. (near *D. pallida* Cook), the feltriid *Feltria faceta* Cook, the mideopsids *Mideopsis (Xystonotus) paramecia* Cook and *M. (X.)* n. sp. (near *M. (X.) delicata*) (Habeeb)), and the neoacarids *Neoacarus similis* Cook and *Volsellacarus* n.sp.nr. *sabulonus* Cook, represent the northern extremes of ranges that extend southward through the Appalachians and, in some cases, to the Ozark Plateau. The water mites *Chappuisides* n.sp.nr. *eremitus* Cook and *Uchidastygacarus acadiensis* Smith represent a group of species restricted to highland areas of the Atlantic Provinces and northern New England, but with conspecific populations or very closely similar sister species in extreme western North America. Some of these species, such as the phytoptids *Sierraphytoptus alnivagrans* Keifer and *Trisetacus neoabietis* Smith, and the mideopsid *Mideopsis (X.)* n. sp. (near *M. (X.) pumila* Cook), have been collected in eastern North America only in Cape Breton.

Newfoundland affinities

by K.G.A. Hamilton

The possibility that Cape Breton Island could have faunal affinities with Newfoundland would seem remote, considering the 125-km water gap between these islands and their very different and characteristic flora. Not much attention has been directed to this subject; consequently only the best-studied faunas can be analysed. Two of these, the macrolepidoptera and Coleoptera, are depauperate in the Park and hence little can be learned from these groups. Leafhoppers, on the other hand, are well represented in both islands and the eastern fauna are becoming known well enough to permit some preliminary conclusions.

There are 214 leafhopper species known from both islands, 111 from Newfoundland and 174 from Cape Breton Island (of which 145 are recorded from the Park). More than a third of the species are in common on both islands, and 1 undescribed species is known only from Newfoundland and Cape Breton Highlands. The bog and fen habitats of Newfoundland and the Park are most similar, both in species diversity and relative abundance of species. Other bogs become progressively depauperate and with different "dominant" species in direct proportion to their distance from the Park. From these facts it becomes clear that the environment in the island bogs represents a relict faunal habitat, perhaps because the year-round conditions (cool and wet) most closely resemble conditions that may have existed adjacent to ice fronts during the glacier advances of the Wisconsinan Period.

Other faunal similarities are found in some tree-feeding groups of leafhoppers. These are possibly relict conditions resulting from the more widespread extensions of the deciduous forest that probably existed during the postglacial warm period, or Hypsithermal (5000-8000 yr BP). For some reason small pockets of southerly flora survived in sheltered bays around the coast of Newfoundland that are not found elsewhere north of Cape Breton Island, and in these locations some apparently relict leafhoppers may be found also. A very few leafhopper species are found only around the coast of the Gulf of St. Lawrence and on Newfoundland and Cape Breton Island, which supports this speculation. Some of these are found in the Park.

That the leafhopper faunal similarities between these two islands is not due to passive wind dispersal can be shown by the fauna of microleafhoppers, the most active fliers and the most easily dispersed by wind. These insects have almost no species in common between these islands.

Lone Shieling Forest

by L. Masner

Fig. 25. Interpretive pathway at Lone Shieling

This information obtained from mature deciduous forests at Lone Shieling shows that this is perhaps the most valuable habitat surveyed during 1983-84. In all probability this forest enclave, flanked by two high ridges, served as a refuge for many faunal and floral elements for a long period of time. With some maple trees estimated to be about 300 years of age, we have sufficient proof of minimum disruption induced by man and his activities. The natural setting of Lone Shieling also contributes towards its exceptional quality. Open to west, and spared from severe storms from the Atlantic Ocean and the harsh winter conditions by the neighbouring ridges, the forest has achieved a wonderful richness and maturity. Located on a large flat valley along the Grande Anse River, it boasts a deep layer of rich, well drained organic soil. Although most of the trees are sugar maples, the corresponding understory is rich in species of both cryptogames and herbaceous plants. The abundance of herbaceous plants is particularly rich along the river. It is the lush growth of ferns, however, that attracts the eye of an entomologist, particularly in spring time. Since Lone Shieling is sheltered from winds and exposed to milder temperatures than surrounding areas, spring arrives well ahead of the neighbouring parts of the Park. Budding and leafing begins here 10-14 days before the same event occurs in the highlands. By the time the young leaves are unfolding in Lone Shieling, thick layers of packed snow still choke the vegetation atop North Mountain, only a couple of kilometers away! By virtue of its magnificent growth of sugar maples, Lone Shieling creates an environment suitable for a rich and highly diversified arthropod fauna. The species of insects associated with sugar maples in eastern North America, such as gall midges and their parasites, are well represented here. The towering trunks of dying forest giants harbour a great diversity of woodboring insects. They also contribute to the deep layer of organic soil, a significant habitat for many terrestrial arthropods. Natural calamities and disasters, such as forest fires, gales or avalanches seem to have not affected Lone Shieling. Consequently, the fauna has remained relatively undisturbed, almost like an oasis amidst the much harsher surroundings. The value of Lone Shieling has been recognized recently by the International Biological Program by selecting this part of the Park as the best example of a mature stand of sugar maple in eastern North America. Certainly this recognition corresponds with the overall results of our surveys. The only other notable formation of mature sugar maples on the island is near the settlement of Meat Cove, north of Lone Shieling. This forest is, however, smaller in size than that at Lone Shieling but still has numerous trees of distinguished size and age. Being outside the limits of the Park, the Meat Cove stand should be considered for special protection.

PART VI ARTHROPODS OF CAPE BRETON HIGHLANDS NATIONAL PARK

SUMMARY

by J.D. Lafontaine

An examination of the preceding pages, and of the table below, reveals two prominent facts. First, a very large number of species of insects and arachnids have been collected in Cape Breton Highlands National Park - more than 4000 species. Second, in spite of intensive collecting activity over a two year period and periodic collecting over a period of many years before this, only slightly more than one-third of the expected species have been found. A more critical analysis of these data, with a comparison of groups, shows why so much more work is required before a higher proportion of the fauna is known.

Groups with large, showy species that are relatively easy to locate, collect and identify are well collected. Examples are butterflies, dragonflies, and grasshoppers. These groups, however, make up only a small portion of the fauna.

The vast majority of groups contain species that require more specialized collecting techniques, and are more difficult to locate and identify in the field. Some groups, such as the larger moths, beetles, flies and wasps, are relatively well collected and about one-half of the expected species have been found. In many groups, such as mites, springtails, micro-moths, parasitic wasps and soil dwelling beetles, specimens are minute and only a fraction of the expected species has been found. A few groups, such as the mites and lice that are parasites of birds and mammals are virtually unknown in the Park, even though many hundreds of species probably occur there.

The following table summarizes the relative size, and completeness of the collections, of each group in the Park. Four orders, Coleoptera, Diptera, Lepidoptera and Hymenoptera make up about two-thirds (63%) of the expected fauna and 70% of the known fauna.

The significance of the arthropod fauna of the Park in terms of preservation and protection of complex communities of arthropods, and the zoogeographic significance of the Park, have been discussed in Parts III, IV, and V. A full understanding of the significance of the Park arthropod fauna will only be possible when a higher portion of the species are known, and when other areas of Canada have been as well collected as Cape Breton Highlands so comparisons can be made.

Census of the insects and arachnids
of Cape Breton Highlands National Park

Class	Order	Estimated number of species in Park	Number of species recorded from Park
Arachnida			
	Araneae	300	233
	Opiliones	4	0
	Pseudoscorpionida	10	4
	Parasitiformes	225	70
	Acariformes	1600	462
Diplopoda		30	3
Chilopoda		?	2
Symphyla		1	0
Insecta			
	Protura	3	0
	Collembola	200	?
	Diplura	?	?
	Microcoryphia	?	0
	Thysanura	?	0
	Ephemeroptera	50	40
	Odonata	40	37
	Plecoptera	35	32
	Dictuoptera	2	0
	Dermaptera	2	1
	Grylloptera	8	7
	Orthoptera	14	10
	Psocoptera	25	0
	Mallophaga	?	0
	Anoplura	20	?
	Homoptera	214	161
	Hemiptera	320	100
	Thysanoptera	15	8
	Megaloptera	2	1
	Neuroptera	20	4
	Coleoptera	1349	770
	Mecoptera	5	2
	Diptera	1900	715
	Siphonaptera	30	0
	Lepidoptera	1044	401
	Trichoptera	50	2
	Hymenoptera	2850	985
TOTAL		11283	4072

PART VII LIST OF CONTRIBUTORS

S. Allyson
J.R. Barron
V.M. Behan-Pelletier
H.E. Bisdee
B.M. Bissett
K.B. Bolte
A. Borkent
Y. Bousquet
D.E. Bright
D.J. Brown
J.M. Campbell
B.E. Cooper
P.T. Dang
M.E. Dillon
C.D. Dondale
L. Dumouchel
R.G. Foottit
H. Goulet
K.G.A. Hamilton
D.H. Kritsch
J.D. Lafontaine
R.A. Layberry
L. LeSage
E.E. Lindquist
J.E.H. Martin
L. Masner
W.R.M. Mason
A. Mutuura
D.R. Oliver
F. Schmid
M.J. Sharkey
A. Smetana
I.M. Smith
H.J. Teskey
J.R. Vockeroth
D.M. Wood