FOLIAGE INSECTS OF SPRUCE IN CANADA

BY

A. W. A. BROWN

Forest Insect Investigations
Division of Entomology

Science Service

Established by authority of the Hon. JAMES G. GARDINER, Minister of Agriculture
Ottawa, Canada
SCIENCE SERVICE

Director, J. M. Swaine, Ph.D., F.R.S.C.

DIVISION OF ENTOMOLOGY

Dominion Entomologist and Chief of Division........... Arthur Gibson, LL.D., F.R.S.C.
Systematic Entomology ...................................... J. H. McDunnough, Ph.D., F.R.S.C.
Field Crop Insect Investigations ............................. H. G. Crawford, M.S.
Forest Insect Investigations ................................. J. J. deGryse, Ph. Cand.
Fruit Insect Investigations ................................. W. A. Ross, B.S.A.

LABORATORIES AND OFFICERS-IN-CHARGE

Annapolis Royal, N.S. ............. Fruit Insect Investigations, A. D. Pickett, M.Sc.
........ Fruit Insect Investigations, R. P. Gorham, B.S.A.
Berthierville, P.Q. ............. Fruit Insect Investigations, L. Daviault, Ph.D.
Hemmingford, P.Q. ............. Fruit Insect Investigations, C. E. Petch, B.S.A.
........ Stored Product Insect Investigations, H. E. Gray, M.S.
Vineland Station, Ont. .......... Fruit Insect Investigations, W. A. Ross, B.S.A.
Simcoe, Ont. ............. Fruit Insect Investigations, J. A. Hall, B.S.A.
Chatham, Ont. ............. Field Crop Insect Investigations, G. M. Stirrett, Ph.D.
Harrow, Ont. ............. Fruit Insect Investigations, W. E. van Steenburgh, Ph.D.
Angus, Ont. ............. Forest Insect Investigations, K. E. Stewart, M.Sc.
Brandon, Man. ............. Field Crop Insect Investigations, R. D. Bird, Ph.D.
Indian Head, Sask. ............. Forest Insect Investigations, L. O. Peterson, M.Sc.
Saskatoon, Sask. ............. Field Crop Insect Investigations, K. M. King, Ph.D.
Agassiz, B.C. ............. Field Crop Insect Investigations, R. Glendenning.
........ Field Crop Insect Investigations, E. R. Buckell, B.A.
........ Fruit Insect Investigations, J. Marshall, Ph.D.
Victoria, B.C. ............. Fruit Insect Investigations, W. Downes.
........ Forest Insect Investigations, M. L. Prebble, Ph.D.

Dominion Forest Insect Laboratory—Ottawa*

Assistant Entomologist ...................................... K. E. Stewart, M.Sc.
Assistant Entomologist ...................................... C. E. Atwood, Ph.D.
Assistant Entomologist ...................................... A. W. A. Brown, Ph.D.
Forest Insect Ranger ........................................ H. S. Fleming.

* Personnel of the Unit from which this publication was issued.
FOLIAGE INSECTS OF SPRUCE IN CANADA

BY

A. W. A. BROWN

Forest Insect Investigations
Division of Entomology

Science Service

Published by authority of the Hon. JAMES G. GARDINER, Minister of Agriculture
Ottawa, Canada
FOLIAGE INSECTS OF SPRUCE IN CANADA

by

A. W. A. BROWN

The information presented in this paper represents a part of the results obtained by the Canadian Forest Insect Survey, a co-operative enterprise between industry, protection services and forest entomologists, launched in 1936. A detailed account of the organization of this project may be found in the Annual Report of the Forest Insect Survey, Division of Entomology, Science Service, Department of Agriculture, Ottawa, 1939.

In addition to the results obtained by the headquarters laboratory at Ottawa, information for their particular regions has been contributed by L. S. Hawboldt of Fredericton, N.B., working under the direction of R. E. Balch, and by H. B. Leech of Vernon, B.C., under the direction of G. R. Hopping.

Mr. A. R. Gobeil, Director, and the staff of the Entomological Service of the Department of Lands and Forests of the Province of Quebec have co-operated very closely with the Dominion Division of Entomology in the Forest Insect Survey. The greater part of the records from central and eastern Quebec are based on collections and rearing experiments made by them. This important contribution is hereby duly and gratefully acknowledged.

Specialized work in various groups has been contributed by the following members of the scientific staff: W. C. McGuffin, larvae of the Lepidoptera; G. A. Bradley, adult Coleoptera, Aphidoidea and Coccidae; W. W. Judd, Hemiptera. Basic assistance has been freely given by Dr. J. McDunnough, Chief of the Systematic Investigations unit, and the following members of his staff: W. J. Brown, Coleoptera; G. S. Walley, Ichneumonoidea and Hemiptera; Dr. O. Peck, Tentredinoidea and Chalcidoidea; G. Shewell, Diptera; T. N. Freeman, Lepidoptera. Miss Jean Burnham of Fredericton has kindly determined certain Aphidoidea, and C. S. Smith of Belleville some parasitic Diptera.

Approximately 37 per cent of the total timber resources of Canada is composed of the 5 species of spruce (Picea), namely, white, red, black, Engelmann, and Sitka, with their intermediate forms. Indeed, about 20 per cent* of all the spruce in the world is to be found in the Dominion, representing a large part of the international pulpwood supply. Since softwoods are easily killed by defoliating insects, a knowledge of the various forms feeding on spruce over the vast extent of Canada is of considerable importance.

The greater number of these forms are larvae of Lepidoptera, of which some 70 species are listed in this paper. The sawflies, however, are in many respects the most important group, although only 6 species have been recognized. There have also been recorded on spruce 8 species of adelgids, 7 aphids, 4 cecopids, 4 fulgorids, and 2 recognized species of coccids. Although outbreaks of leaf-eating insects occur very often in Canada, there are only 2 species of outstanding importance at the present time: namely, the spruce budworm, Cacoecia fumiferana Clem., a native insect; and the European spruce sawfly, Gilpinia polytoma Htg., first noted in 1930. Probably 8 other species are more

* Estimate kindly supplied by J. D. B. Harrison, Dominion Forest Service.
or less harmful, the most common of these being the native yellow-headed spruce sawfly and balsam fir sawfly. It should be remembered, however, that species which are usually unimportant in the forest may at times cause considerable damage in nurseries and ornamental plantations, and that, under circumstances particularly favourable to their multiplication, certain species may unexpectedly become forest pests of the first rank.

It is remarkable that of the 101 species of foliage insects listed in this paper as spruce feeders, only 6 species can be said to attack no other trees. These are the sawflies Gilpinia polytoma, the 2 species of Pikonema, the caterpillar Taniva albolineana, and the gall-aphids Adelges abietis and probably Pineus similis. However, the caterpillars Zeiraphera ratzeburgiana and Z. fortunana, Dioryctria reniculella and Zanclognatha minoralis may possibly belong to this category. The forms that feed on other softwoods as well are much more numerous. An insect which prefers spruce will nearly always attack balsam also. Finally, some of the insects found on spruce are general feeders and may occur on broadleaved trees and even shrubs and herbs.

Great variety in the manner of feeding is to be observed in these forms. The following 9 types of attack may be noted:

1. Mainly restricted to old foliage, as in Gilpinia polytoma and Neodiprion abietis.
2. Mainly restricted to new foliage, as in Pikonema.
3. All foliage eaten indiscriminately, as in most Macrolepidoptera.
4. Needles lightly webbed together, as in Tortricidae.
5. Restricted to sprouting shoots, as in Caccoecia and Peronea.
6. Needle-mining, as in Taniva, Epinotia and Recurvaria.
7. Foliage drawn together to form "frass nests", as in Cephalcia and Dioryctria.
8. Surface of shoot attacked, as in cereopids and fulgorids.

The following pages list the insect species feeding on spruce, together with notes on their most important characteristics. Where possible each is given a common name taken from authorized lists or from special publications, or, in some cases, made up for use in connection with the survey. For each species the total number of samples received in the Forest Insect Survey followed by the total number of specimens is shown in brackets immediately after the name of the species. Information on geographical range has been compiled from the detailed distribution maps on which every sample of the species concerned is plotted. The first and last dates of emergence are then given. In cases of emergence after hibernation, the figures following the term "incubation" indicate the number of days spent in an incubator at 75° F and 95 per cent R.H. Whenever a list of parasites is given, the order followed shows which species are most often represented in the samples received. Since nearly all host insects collected in the survey were in the larval stage, many pupal and cocoon parasites are lacking. Supplemental information obtained from literature or from specimens in the Canadian National Collection will be found in brackets. Each section closes with one or more references to biology or larval description, where available.

A section of this paper has been devoted to the principal predacious groups to be found on spruce foliage, namely the hemerobiids, chrysopids, syrphids, pentatomids, carabids, clerids, melyrids and coccinellids. In many cases only the number of samples received, but not the number of specimens, is indicated, and other information available in the divisional files has been either presented in condensed form or completely omitted. This section is closed by a list of 20
of the most common species that may be beaten from spruce. These are almost entirely composed of elaterids, whose larvae prey on sawfly cocoons, and of wood-boring insects.

At the end of this paper there is a series of keys to the most important species covered in the text. These keys have been made as simple as possible, making full use of colour characteristics and features that may be seen with a hand lens; the small number of the species concerned has made these liberties possible. It should be distinctly understood that these keys are intended for use only in the determination of species actually found on spruce. Thus it is hoped that by the introduction of keys and of suitable common names, this paper may be of value to every field man, whether forest entomologist, forester, or forest ranger.

**TENTHREDINIDAE—Sawflies**

*Neodiprion abietis* Harr. Balsam fir sawfly. (691:7464).—White, black, red, Engelmann and Sitka spruce; also balsam. (Specimens on red and jack pine are a separate species; those on balsam, on eastern spruces, and on western spruces may constitute 3 separate subspecies.*) Very common, occasionally defoliating quite seriously balsam, and also spruce. Skeena River to Churchill River, James Bay and Newfoundland, south to United States border. Overwintering: egg. Cocooning: June 19 to July 27 (average July 10). Emergence: July 11 to September 3 (average August 4). Sex ratio 66 per cent. Pupal parasitism 10 per cent (2 per cent summer emergence, 8 per cent following spring).

**Parasites:**
- *Phorocera near hamata A. & W.*
- *Spathimeigenia spinigera Tns.*
- *Spathimeigenia aurifrons Curr.*
- *Lamachus lophyri Ashm.*
- *Lamachus contortionis Dav.*
- *Amblymerus verditer Nort.*
- *Lamachus ruficosta Cush.*
- *Delomerista dipriomis Ashm.*
- *Hemieles tenellus Say (hyperparasite).*
- *Euceros frigidus Cress.*
- *Bessa selecta Mg.*
- *Ezenterus affinis Rohw.*
- *Mesochorus spp. (hyperparasite).*
- *Gelis sp. (hyperparasite).*

*Atwood, C. E., personal communication.

*Gilpinia polytoma* Htg. European spruce sawfly. (3229:110547).—White, red, black and Norway spruce. Exceedingly destructive and persistent infestation since discovery in 1930. Lake Abitibi, Georgian Bay and Lake Huron, east to Anticosti Island, Cape Breton Island and Nova Scotia; extremely rare in Gatinou and Algouqin regions. Generations: mainly 1 in Northern Coniferous Forest, mainly 2 in Mixed Forest. Overwintering: prepupa in cocoon, a certain proportion exhibiting diapause for 2 to 7 years. Cocooning July 1 to November 13. Emergence: incubation 11 to 52 (average 14) days; (summer generation July 6 to September 16). Sex ratio 99.5 per cent. Pupal parasitism 0-1 per cent.

**Parasites:**
- *Microplectron fuscipennis Zett.*
- *Bessa selecta Mg.*
- *Ezenterus sp.*
- *Phorocera near hamata A. & W.*
- **Spathimeigenia aurifrons Curr.**
- **Spathimeigenia spinigera Tns.**
- *Lamachus contortionis Dav.*
- *Aptesis indistincta Prov.*
- *Aenoplex sp.*
- *Stylocryptus subclavatus Say.*

*Introduced parasite.*
**May be two intergraded forms of *S. spinigera* (C. S. Smith).*

Parasites: *Erromenus bedardi* Prov.  
*Monoblastus* n. sp.  
*Scopiorus quebecensis* Prov.  
*Bessa selecta* Mg.  
*Smicroplectus velox* Wyl.  
*Phorocera near kamata* A. & W.  
*Mesoleius* sp.  
*Hypopteromatus tabacum* Fitch (hyperparasite).  
*Holocremnus* sp.  
*Orthostigma* sp.  
*Brachymeria compsilucae* Cwfd.  
*Euceros* sp.  
*Monoblastus? varifrons* Cress.  
*Melittobia chalybi* Ashm.  
*Mesochorus* spp. (hyperparasite).


Parasites: *Erromenus bedardi* Prov.  
*Holocremnus* sp.  
*Scopiorus quebecensis* Prov.  
*Monoblastus* n. sp.  
*Mesochorus* sp. (hyperparasite).


**PAMPHILIIDAE**—False Webworms

*Acantholyda* sp. Evergreen false webworm. (87:95).—White, black and Engelmann spruce; also balsam, hemlock, white and jack pine. Common but apparently never destructive. British Columbia interior, Northwest Territories, Saskatchewan, Manitoba, Ontario, Quebec and New Brunswick. Overwintering: prepupa in soil. Cocooning; entered soil about June 23. Emergence: incubation period 4 to 5 days; may exhibit diapause for one or more years.

*Cephalcia* sp. Orange-striped false webworm. (70:130).—White, black and Engelmann spruce; also white, red and jack pine. Common, with occasional local infestations. British Columbia interior, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, and Newfoundland. Overwintering: prepupa in soil. Cocooning; entered soil about August 1. Emergence: incubation period 17 to 29 days; may exhibit diapause for one or more years.

Parasite: *Zenillia fronto* Coq.

**ARCTIIDAE**—Tiger Moths


Parasite: *Amblyteles sp.*
**Panthea acronyctoides** Wlk. Spruce tufted caterpillar. (106:117).—White and black spruce; also balsam, tamarack and white pine. Common but unimportant. Lake Winnipeg to Lake Abitibi, Lake St. John and Gaspe, south to United States border. Overwintering: pupa. Pupation: July 21 to September 28 (average August 20). Emergence: incubation period 8 to 18 (average 10) days (June 27 to August 5). Sex ratio 57 per cent. Pupal parasitism 11 per cent.

**Parasite:** *Apanteles near congregatus* Say.


**Anomogyna eldima** Wlk. Chameleon caterpillar. (19:23).—White, black and Engelmann spruce; also balsam, hemlock, red and jack pine. Not uncommon (record of great abundance at Nitchequon in far northern Quebec). Ontario, Quebec, New Brunswick; also northern Alberta (this may be a variety). Overwintering: larva. Pupation: June 17 to July 17. Emergence: July 22 to August 16. Sex ratio 53 per cent.


**Anomogyna perquiritata** Morr. (13:22).—White and black spruce; and balsam. Also Engelmann spruce (this may be a variety). Generally uncommon. (British Columbia), northern Alberta to Gulf of St. Lawrence (and Newfoundland); common in northern Quebec. Overwintering: larva. Pupation: June 25 to July 12. Emergence: July 13 to 29.

**Feralia jocosa** Gn. Green-striped spruce caterpillar. (394:408).—White, black and Engelmann spruce; also balsam, hemlock, and jack pine. Common but unimportant. South-eastern British Columbia, Saskatchewan to Chibougamau, Anticosti Island and Cape Breton, south to United States border. Overwintering: pupa. Pupation: July 19 to September 20. Emergence: incubation period 2 to 3 days (April 20 to May 30); very susceptible to drying out as pupa. Pupal parasitism 5 per cent.

**Parasites:** *Madremyia saundersii* Will.

*Euplectrus* sp.


**Feralia major** Sm. (2:3).—White spruce. Rare. Ontario and northeastern Quebec. Overwintering: larva. Pupation: August 16 to 22. Emergence: incubation period 1 to 9 days (April 20 to May 10).

**Elaphria versicolor** Grt. Fir harlequin. (399:620).—White, black and red spruce; also balsam, tamarack and white cedar; yellow birch, walnut and oak. Common, occasionally partly defoliating balsam. Lake Winnipeg to Lake St. John, Cote Nord and Maritimes; more common in Eastern Canada. Generation: 1 (2 in Virginia). Overwintering: pupa. Pupation: August 5 to September 22 (average September 1). Emergence: incubation period 10 to 15 days (June 7 to July 3). Sex ratio 56 per cent. Pupal parasitism: 15 to 38 per cent.

**Parasites:** *Chaetophlepsis prob. orbitalis* Web.

*Wagneria helymus* Wlk.


**Parasite:** *Copidosoma* sp.


**Emergence:** Notolophus Zanclognatha Olene Autographa Parasites: blue unimportant. 25 larva. August also to ornamental and loose spruce, southern British Columbia and northwestern Ontario, (Quebec and Nova Scotia). Overwintering: larva (?). Pupation: June 23. Emergence: July 2.

**Epizeuxis americalis** Gn. (3:3).—White spruce, (described as destructive on sweet corn and leguminous plants, and as an inquiline in ants' nests). Rare. (British Columbia to Saskatchewan), southern Manitoba and northwestern Ontario, (Quebec and Nova Scotia). Overwintering: larva (?). Pupation: June 23. Emergence: July 2.
Ref.: Freeman, T. N., personal communication.


**Palthia angulalis** Hbn. Spruce harlequin. (63:75).—White, black, red, Englemann and Sitka spruce, also balsam. Unimportant but fairly common. All British Columbia; Lake Superior to Lake Abitibi, Gaspé and Newfoundland, south to United States border (record from Italy of German authors doubted by Guenée). Overwintering: prepupa in loose cocoon, spun August 16 to October 16. Pupation: incubation period 6 days (June 23). Emergence: incubation period 14 to 18 days (May 31 to July 5).

**LIPARIDAE—Tussock Moths**

**Notolophus antiqua** L. Rusty tussock moth. (132:698).—White, black, red and blue spruce; also tamarack, and deciduous trees, shrubs and herbs. Common; often abundant on blue spruce, and quite destructive to certain deciduous trees. Prince Albert to Lake Abitibi, Gaspé and Newfoundland, and south to United States border. Overwintering: larva. Pupation: July 9 to August 24. Emergence: July 29 to September 12. Sex ratio 25 to 33 per cent. Pupal parasitism 8 to 15 per cent.

Parasites: *Ilopectes conquistor* Say.
*Isorropus coelebs* Wlshm.
*Casinaria orgyae* How.
*Hyposoter paltipes* Prov.
*Amblytes unifasciatorius* Say.
*Exorista mella* Fitch.
*Campoplex sp.*


**Olene plagiata** Wlk. Grey spruce tussock moth. (127:141).—White and black spruce; also white pine and other conifers, and elm, yellow birch and basswood. Common but unimportant, in Churchill Lakes and Gulf of St. Lawrence, and south to United States border. Overwintering: larva. Pupation: June 15 to July 8 (but larvae found until September 2). Emergence: June 24 to August 10 (average July 20). Sex ratio 52 per cent. Pupal parasitism: 24 per cent.

Parasites: *Compsilura concinnata* Mg.
*Casinaria orgyae* How.
*Sturmia sternalis* Coq.
*Zenillia amplexa* Coq.

Ref.: Ibid. Species in this genus are insufficiently characterized.
**GEOMETRIDAE—Loopers**

*Nemoria minosaria* Gn. (5:8).—White spruce; also balsam, hemlock and tamarack, and oak. Rare. (Manitoba), Ontario, Quebec—Gatineau and Lievre valleys, (Nova Scotia). Overwintering: pupa. Pupation: August 28 to 31. Emergence: incubation period 12 days (June 2 to 29).


*Nyctobia limitaria* Wlk. (11:16).—White, black, red and Engelmann spruce; also tamarack. Not common. British Columbia interior, northwestern Ontario, lower St. Lawrence river and New Brunswick. Overwintering: pupa. Pupation: July 9 to 20. Emergence: incubation period 5 days (also 38 days).

**Parasites:** Chorinaceus sp. Proctotrupididae sp.


**Parasite:** Casinaria sp.

*Eupithecia luteata* Pack. Fir-needle inchworm. (8:11).—White, and red spruce; also balsam (white pine and juniper). Not uncommon. (Manitoba), Ontario, Quebec, New Brunswick. Overwintering: pupa. Pupation: August 11 to September 14 (average August 31). Emergence: incubation period 9 to 12 days (May 26 to July 15).


*Hydriomena divisaria* Wlk. Transverse-banded looper. (1682:5077).—White, black and red spruce; also balsam and tamarack. Unimportant but common. Northern Saskatchewan to Gulf of St. Lawrence and Cape Breton, south to United States border. Overwintering: pupa. Pupation: August 25 to November 22. Emergence: incubation period 7 to 14 days (May 28 to July 7). Sex ratio 55 per cent. Pupal parasitism 8 per cent, 9 per cent, 5 per cent.


*Semiothisa granitata* Gn. Green spruce looper. (1682:5077).—White, black and red spruce; occasionally on balsam and tamarack. (Also a larger form in British Columbia on Engelmann and Sitka spruce, Douglas fir, western hemlock and alpine fir.) Unimportant but exceedingly common. British Columbia entire (larger form); northern Saskatchewan to Gulf of St. Lawrence and Newfoundland and south to United States border. Generation: 1 (occasional emergence in late summer). Overwintering: pupa. Pupation: August 7 to October 23. Emergence: incubation period 8 to 13 (occasionally up to 101) days (May 28 to July 10). Sex ratio 65 per cent. Pupal parasitism 36 per cent, 33 per cent, 13 per cent.

15935—2
Parasites: Casmatoria sp. / Rhagotet spp. / Mesochorus spp. (hyperparasite). / Chaetopteraphis orbitalis Webb. / Hyposoter near geometrae Ashm. / Microgaster probably new sp. / Euceros couperi Cress. / Ophiom sp. / Metaceras reticulatus Mues. / Campoplegidea vicina Prov. / Campoplegidea lobata Wly. / Campoplex sp. / Platylabus ornatus Prov. / Amblytele sp. / Microplitis n.sp. / Euceros frigidus Cress. / Theletia rodora sp. / Apanteles sp. / Macrocentrus uniformis Prov. / Paranomalon sp. / Chlorinaeus probably new sp. / Madremyia saundersi Will.


*Euforida notatura* Wlk. (13:20).—White, black and red spruce; mainly on white and jack pine, also on tamarack and hemlock. Uncommon. Northern Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia. Overwintering: pupa. Pupation: August 14 to 20. Emergence: incubation period 12 to 15 days (June 7 to July 5). Sex ratio 63 per cent.


*Goodell*. Can. Ent., 14, 199.


*Paraphia caeruleus* Cress.


*Paraphia*: Astiphromma sp.

Ref.: Dyar. Psyche, 12, 58 (described under M. canadaria).

*Protoboaarmia porcelaria* Gn. Dotted-line looper. (245:513).—White spruce; also balsam, tamarack and white pine. Quite common. Northern Saskatchewan and Manitoba to Gulf of St. Lawrence, south to United States border. Generations: 2 successive broods (both univoltine). Overwintering: larva, occasionally as pupa. Pupation: June 13 to July 5 (summer generation); November 10 (overwintering as pupa). Emergence: June 22 to July 19 (summer generation); May 10 (overwintering as pupa).

*Parasites*: Amblytele sp. / Acrotermes acutus Cress. / Pimpla pedalis Say. / Macrocentrus uniformis Prov. / Apanteles sp. / Platylabus sp. / Euceros sp.

Protoboarmia porcelaria indicataria Wlk. Western dotted-line looper. (10:15).—Engelmann spruce; also Douglas fir, western cedar, western hemlock, and lodgepole pine. Quite common. British Columbia, (Alberta). Generations: 2 successive broods (both univoltine). Overwintering: larva or pupa. Pupation: June 29 to July 18 (summer generation); August 1 to October 15 (overwintering as pupa). Emergence: July 21 to August 3 (summer generation); incubation period 5 to 52 days, or June 21 to July 10 (overwintering as pupa).

Ref.: McDunnough. Ibid, p. 31.

Anacampptodes larvaria Gn. (8:8).—White and black spruce; also balsam and tamarack. Emergence: June 11 to July 18.
Ref.: McDunnough. Ibid, p. 29.

Parasites: Aphanistes sp.
Amblyteles sp.


Nepytia canosaria Wlk. False hemlock looper. (347:630).—White, black, red and Engelmann spruce; also hemlock, red pine, white cedar, tamarack and Douglas fir. Abundant but not important. Southeastern British Columbia; northern Saskatchewan to Lake Abitibi, Cote Nord and Maritimes, south to Lake Ontario. Overwintering: egg. Pupation: July 7 to August 25 (average August 2). Emergence: August 9 to October (average August 25). Sex ratio 70 per cent. Pupal parasitism 10 per cent, 12 per cent.
Parasites: Madremyia Saundersii Will.
Meteorus Hyphantriae Ril.
Meteorus near vulgarius Cress.
Itoplectis consiquitor Say.
Apechthis ontario Cress.
Zenilla blanda O.S.
Zele sp.
Amblyteles puerilis Cress.
Apanteles sp.
Mesochorus sp. (hyperparasite).

N.B.—Two larval colour phases, green and crimson, yield similar adults; about 20 per cent of larvae are crimson phase.

Parasite: Chaetophlepsis orbitalis Webb.

Lawrence, south to United States border (not yet found in southwestern Ontario). Overwintering: pupa. Pupation: August 27 to November 9 (average October 1). Emergence: incubation period 15 to 48 (average 24) days (June 24 to August 1). Sex ratio 58 per cent. Pupal parasitism 18 per cent, 26 per cent, 3 per cent.

Parasites: Madremyia Saundersi Will.  
Cassania sp.  
Thecladoria sp.  
Eucercus couperi Cress.  
Paranaloon sp.  
Macrocentrus uniformis Prov.  
Zeniilia blanda O.S.

Ellopia fiscellaria Gn. Hemlock looper. (486:1304).—White, black and red spruce; also hemlock, balsam, red pine, white cedar and trembling aspen. Destructive on hemlock in Great Lakes region, on balsam around Gulf of St. Lawrence; common but unimportant on spruce. Lake Winnipeg to Lake Abitibi and Newfoundland, south to United States border. Overwintering: egg. Pupation: July 24 to August 27 (average August 5). Emergence: August 3 to October 1 (average August 26). Sex ratio 54 per cent (68 per cent). Pupal parasitism 7 per cent, 9 per cent, 16 per cent.

Parasites: (Winthemia sp.)  
Chaetopleis orbitalis Webb.  
Madremyia Saundersi Will.  
Amblytes velox Cress.  
Blondelia near eufichiae Tns.  
Apechthis ontario Cress.  
Campoplegidea ellopiae Wyl.  
Zele sp.

Ref.: de Gryse & Scheldl. Scientific Agr., 14, 23.  
Watson. Ibid, 14, 669.

Ellopia fiscellaria lugubrosa Hlst. Western hemlock looper. (54:181).—Engelmann and Sitka spruce; (mainly western hemlock, also alpine fir, Douglas fir, western white pine and some hardwoods). Destructive infestations in western hemlock types through south coastal British Columbia, and in the interior mountains in spruce types. British Columbia entire. Overwintering: egg. Pupation: July 11 to September 3 (average August 14). Emergence: August 16 to October 18 (average September 1). Sex ratio 73 per cent (33 per cent Hopping). Pupal parasitism 25 per cent.

Parasites: Hypoaster near geometrace Ashm.  
Apechthis ontario Cress.  
Apanteles sp.  
Mesochorus sp. (hyperparasite).


Parasite: Zenilia blanda O.S.

Ref.: Psyche, 9, 250.

Tetrasis lorata Grt. (8:9).—White spruce; also tamarack, balsam, (hemlock), and willow (and black cherry). Not common. Ontario, Quebec, New Brunswick. Overwintering: pupa. Pupation: September 11. Emergence: incubation period 13 days.


**PYRALIDAE—Snout Moths**

Herculia thymetusalis Wlk. Spruce needle worm. (24:52).—White and black spruce; single record from jack pine. Unimportant but quite common. Northern Saskatchewan to James Bay, Gulf of St. Lawrence and Maritime, south to Ottawa River. Overwintering: larva (occasionally as pupa). Pupation: May 18 to July 4 (occasionally in previous September). Emergence: June 1 to July 20 (occasionally in previous September).

Parasite: Meteorus sp.
Dioryctria reniculella Grg. Spruce cone worm. (39:151).—White spruce; cones, twigs and buds. Common, frequently serious on open-grown and young spruce. Saskatchewan, Manitoba, Ontario, Quebec. Overwintering: pupa. Pupation: September 20 to November 2. Emergence: incubation period 12 to 20 days (June 16 to 18). Sex ratio 51 per cent.  
Parasites: Microbracon sp.  
Epirus sp.  
Erigorus sp.  
Phaedroctonus sp.  

Dioryctria reniculella Grg. Foliage form of the above; adults similar but may prove to be a separate species. (26:35).—White spruce; also Engelmann and occasionally black spruce. Local; frequently mixed with spruce budworm larvae. Central British Columbia, Ontario, Quebec, New Brunswick; 75 per cent of samples come from Algoma. Overwintering: larva. Pupation: July 12. Emergence: July 8 to 20.

Dioryctria abietella D. & S. Cone pyralid. (2:3).—White spruce. Apparently uncommon. Europe; (British Columbia, Alberta), Ontario, (Quebec), Nova Scotia. Overwintering: pupa. Pupation: September 30. Emergence: October 16; however 2 flights—early (June 20 to August 3) and late (September 22 to October 22).

Olethreutidae—Shoot-moths


Parasite: Clistomorpha dorsalis Coq.  


Tortricidae—Leaf Rollers


Cacoecia fumiferana Clem. Spruce budworm. (527:3864).—White, black, red, Engelmann, Sitka and Norway spruce; mainly balsam, also alpine fir, Douglas fir, tamarack and hemlock. Very destructive; widespread periodic infestations lasting 3 to 5 years, typically causing mortality of 90 per cent balsam, 10 per cent spruce. Prince Rupert to Great Slave Lake, Lake Winnipeg, Lake Abitibi to Anticosti Island and Maritimes, south to United States border. Generation: 1 (1 generation in 2 years in northern British Columbia). Overwintering: young larva. Pupation: June 5 to July 26 (average June 26). Emergence: June 16 to August 7 (average July 10). Sex ratio 58 per cent. Pupal parasitism 15 per cent, 18 per cent.

Parasites: Itopletis conquistor Say.
  Apochthys ontario Cress.
  Phaeogenes hariolius Cress.
  Zenilla caesar Aldr.
  Glypta fumiferanae Vier.
  Nemorilla maculosa Mg.
  Meteorus trachynotus Vier.
  Zenilla vulgaris Fall.
  Winthemia fumiferanae Toth.
  Amblymerus verditer Nort.
  Actia interrupta Curr.
  Ascogaster sp.
  Hypopteromalus sp. (hyperparasite).
  Eulophus sp.
  Apaneles sp.
  Amblymerus sp.
  Lypha dubia Fall.
  Sarcoptiphaga sp.


Parasite: Macrocentrus possibly peroneae Mues.


Argyrotaenia lutosana Clem. Fall spruce needle moth. (124:198).—White, black and Engelmann spruce; occasionally on balsam, tamarack and lodgepole pine. Common but generally unimportant. Northern and southeastern British Columbia, Kenora along height of land to Gulf of St. Lawrence and New Brunswick; rare in southern Ontario. Overwintering: pupa. Pupation: August 30 to October 6 (average September 18). Emergence: incubation period 6 to 14 days (average 8 days). Sex ratio 62 per cent. Pupal parasitism 15 per cent, 20 per cent.

Parasites: Exochus pallipes Cress.
  Phytophlebus annulatus Prov.
  Glypta sp.
  Ectybus pleuralis Prov.
  Chorinaeus sp.

Parasites:  Phytodietus sp.
Phytodietus annulatus Prov.
Ezochus sp.
Ezochus annulicrus Wlshm.
Phaeogenes gaspesianus Prov.
Anachaeotopus tortricis Coq.
Campoplex sp.
Atrometus clavipes Dav.
Meteorus trachynotus Vier.
Microgaster peroneae Wlsh.
Actia diffidens Curr.
Nemorilla maculosa Mg.
Eubadizon sp.
Eclytus (?)." probable pleuralis Prov.
Ascoaster sp.
Dioctes obliteratus Cress.
Labrorychus sp.
Hemiteles lenellus Say.
Mesochorus spp. (hyperparasite).
Ephialtes montana Cush.


GELECHIIDAE—Leaf Miners


There remains a number of species in the Lepidoptera whose larvae, feeding mainly on other hosts, are occasionally found on spruce:

Lasiocampidae  Tolyte laricis Fitch Larch lappet moth
Phalaenidae  Acronicta spp. esp. grisea Wlk. Daggers
impressa Wlk. Daggers
fragilis Gn. Daggers

Graptolotha spp.
est. inominata Sm. Fruit worms
baileyi Gt.

Zale spp.
est. near helata Sm. Grey underwings
near benesignata Harv.

Geometridae  Alsophila pometaria Harr. Fall cankerworm
Eupithecia gibsonata Tayl.
Vitrinella pampharina Gn.
Prochoerodes transversata Dru.

Tortricidae  Cacoecia rosaceana Harr. Oblique-banded leaf roller

CERCOPIDAE—Spittle Bugs

Aphrophora parallela Say. Pine spittle bug. (201).—White and black spruce; mainly Jack, Scots, red and white pine; also balsam, hemlock and tamarack. Common; occasionally destructive to young pines. Northern Saskatchewan to Lake Abitibi and Gulf of St. Lawrence, south to United States border. Adults: July 4 to September 30.

Aphrophora saratogensis Fitch. Saratoga spittle bug. (60).—White and black spruce; mainly (Scots and) white pine. Northern Saskatchewan to Lake Abitibi and Maritimes, south to United States border. Abundant in Gatineau valley. Adults: July 17 to October 2.

Aphrophora signoreti Fitch. Signoret's spittle bug. (52).—White, black and Engelmann spruce; also balsam, Douglas fir, tamarack and jack pine. British Columbia entire; Northern Saskatchewan to Lake Abitibi, Cote Nord and Maritimes, south to United States border. Adults: June 19 to September 22.

FULGORIDAE—Lantern Bugs

Epipneta slossoni Van D. Slosson’s lantern bug. (54).—White, black and Engelmann spruce; also balsam, alpine fir, tamarack, jack and white pine. Northern British Columbia and interior; Great Slave Lake to James Bay, Cote Nord and Maritimes, south to Saull Ste. Marie and Ottawa River. Adults: June 2 to September 28.


APHIDIDAE—Aphids


ADELGUIDAE—Gall Aphids


Adelges lariciatus Patch. No specimens. White spruce. Overwintering on tamarack. (New Brunswick.) Gall almost indistinguishable from that of A. abietis.


Pineus similis Gill. Ragged spruce-gall aphid. (18).—White (black, red) and Norway spruce. Overwintering possibly on spruce. Saskatchewan, Manitoba, Ontario, Quebec. Samples: June 6 to July 15.

Pineus floccus Patch. No specimens. Red and black spruce. Overwintering on white pine. (New Brunswick.)

Pineus boycei Annand. (6).—Sitka and Engelmann spruce. British Columbia coast, also interior. Samples: July 12 to August 22.

COCCIDAE—Scales


PREDATORS

HEMEROBIIDAE

Hemerobius conjunctus Fitch. (17:21).—On white and Engelmann spruce; jack and lodgepole pine. British Columbia interior northwest to Yukon; northern Alberta to northern Ontario and western Quebec. Adults: June 10 to September 30.


Hemerobius stigmaterus Fitch. On white spruce, balsam, jack and lodgepole pine. Northern British Columbia to Kenora and northwestern Quebec. Adults: July 27 to September 16.

Kimminsia longifrons Wilk. (10:10).—On white, black and Engelmann spruce. British Columbia interior, Manitoba and Quebec. Adults: June 17 to August 27.
CHrysopidae—Lacewing Flies

Chrysopa harrisii Fitch. (5:26).—On white spruce; also mugo pine. Southern Ontario and southern Quebec. Cocooning: June 22 to August 20. Emergence: August 3 to September 12.
Parasites: Chrysopoconus rileyi Fitch.
*Hemiteles tenellus* Say (hyperparasite).


Chrysopa plurabunda californica Coq. (4:5).—Engelmann and Sitka spruce; also Douglas fir and tamarack. British Columbia entire; northern Saskatchewan. Cocooning: June 30 to July 31. Emergence: July 26 to August 30.


Syrphidae—Hover Flies

Parasite: Syrphoconus agilis Cress.

Pentatomidae—Soldier bugs and Stink bugs

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of samples</th>
<th>Geographical range of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brochymena quadripustulata Fab.</td>
<td>2</td>
<td>Southern Ontario.</td>
</tr>
<tr>
<td>Brochymena arborea Say.</td>
<td>5</td>
<td>Southern Ontario, southern Quebec.</td>
</tr>
<tr>
<td>Peribalus piceus Dall.</td>
<td>1</td>
<td>Saskatchewan.</td>
</tr>
<tr>
<td><em>Chlorochroa uhleri</em> Stal.</td>
<td>10</td>
<td>British Columbia coast and interior, Ontario and Quebec.</td>
</tr>
<tr>
<td>Euschistus euschiroides Voll.</td>
<td>10</td>
<td>British Columbia coast and interior, Saskatchewan, Ontario, Quebec.</td>
</tr>
<tr>
<td>Euschistus tristigmus Say.</td>
<td>148</td>
<td>Kenora to Lake St. John, New Brunswick and Nova Scotia, south to United States border.</td>
</tr>
<tr>
<td>Neottiglossa undata Say.</td>
<td>2</td>
<td>British Columbia interior.</td>
</tr>
<tr>
<td>Cosmopepla bimaculata Thom.</td>
<td>9</td>
<td>Northern and central British Columbia, Quebec, Prince Edward Island.</td>
</tr>
<tr>
<td>Banasa dimidiata Say.</td>
<td>69</td>
<td>Southern British Columbia (coast and interior); Algoma to Lake St. John, New Brunswick and Nova Scotia.</td>
</tr>
<tr>
<td>(Banasa stink bug.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banasa sordida Uhl.</td>
<td>1</td>
<td>British Columbia coast.</td>
</tr>
<tr>
<td>Meadorus lateralis Say.</td>
<td>153</td>
<td>British Columbia coast and interior, Lake Athabaska to Anticosti and Nova Scotia south to United States border.</td>
</tr>
<tr>
<td>Elasmostethus cruciatus Say.</td>
<td>87</td>
<td>British Columbia entire; Lake Athabaska to Newfoundland and New Brunswick.</td>
</tr>
<tr>
<td>Elasmostethus interstinctinus L.</td>
<td>1</td>
<td>Northwest Territories.</td>
</tr>
<tr>
<td><em>Perillus exactus</em> Say.</td>
<td>1</td>
<td>British Columbia coast.</td>
</tr>
<tr>
<td><em>Apateticus cynicus</em> Say.</td>
<td>1</td>
<td>Ontario.</td>
</tr>
<tr>
<td><em>Podisus modestus</em> Dall.</td>
<td>28</td>
<td>Northern and eastern British Columbia, Ontario, Quebec, New Brunswick.</td>
</tr>
<tr>
<td>(Modest soldier bug.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Podisus placidus</em> Uhl.</td>
<td>1</td>
<td>Southern Ontario.</td>
</tr>
<tr>
<td><em>Podisus serienvestris</em> Uhl.</td>
<td>172</td>
<td>Southeastern British Columbia; Manitoba to Gaspé and Maritimes, south to United States border.</td>
</tr>
<tr>
<td>(Forest soldier bug.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zicrma caerulea L.</td>
<td>1</td>
<td>New Brunswick (Europe, Asia, East Indies).</td>
</tr>
</tbody>
</table>

*Species known to be predacious.*
## CARABIDAE—Ground Beetles

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of samples</th>
<th>Geographical range of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pemphus angusticollis</em> Mann.</td>
<td>3</td>
<td>British Columbia coast.</td>
</tr>
<tr>
<td><em>Sphaeroderus lecontei</em> Dej.</td>
<td>3</td>
<td>Ontario, Quebec.</td>
</tr>
<tr>
<td><em>Calosoma frigidum</em> Kby.</td>
<td>2</td>
<td>Ontario.</td>
</tr>
<tr>
<td><em>Calosoma calidum</em> Fab.</td>
<td>1</td>
<td>Ontario.</td>
</tr>
<tr>
<td><em>Leistus ferruginosus</em> Mann.</td>
<td>1</td>
<td>Northern British Columbia.</td>
</tr>
<tr>
<td><em>Holciorhorus ater</em> Dej.</td>
<td>8</td>
<td>British Columbia coast.</td>
</tr>
<tr>
<td><em>Eucerona coracia</em> Newm.</td>
<td>2</td>
<td>Quebec.</td>
</tr>
<tr>
<td><em>Lyperophorus punctatissimus</em> Rand.</td>
<td>3</td>
<td>Quebec.</td>
</tr>
<tr>
<td><em>Bothriopteris lucotis</em> Dej.</td>
<td>1</td>
<td>Quebec.</td>
</tr>
<tr>
<td><em>Perosia obesa</em> Say.</td>
<td>1</td>
<td>Manitoba.</td>
</tr>
<tr>
<td><em>Platynus sinuatus</em> Dej.</td>
<td>118</td>
<td>Northern British Columbia; northern Saskatchewan to James Bay and Gulf of St. Lawrence, south to United States border.</td>
</tr>
<tr>
<td><em>(Lithe ground beetle.)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Platynus quadrripunctatus</em> Dej.</td>
<td>7</td>
<td>Rocky Mountains, Manitoba, Ontario, Quebec.</td>
</tr>
<tr>
<td><em>Platynus bogemanni</em> Gyll.</td>
<td>1</td>
<td>Quebec.</td>
</tr>
<tr>
<td><em>Lebia grandis</em> Hentz.</td>
<td>1</td>
<td>Ontario.</td>
</tr>
<tr>
<td><em>Dromius piceus</em> Dej.</td>
<td>12</td>
<td>British Columbia interior, Quebec.</td>
</tr>
<tr>
<td><em>Plchionus timidus</em> Hald. (Shy ground beetle.)</td>
<td>69</td>
<td>Northern Manitoba and Kenora to Ottawa valley and Matapedia; rare in Maritimes.</td>
</tr>
<tr>
<td><em>Anadaptus baltimorenensis</em> Say.</td>
<td>1</td>
<td>Quebec.</td>
</tr>
</tbody>
</table>

## CLERIDAE—Checkered Beetles

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of samples</th>
<th>Geographical range of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Trichodes nuttalli</em> Kby.</td>
<td>1</td>
<td>Ontario.</td>
</tr>
<tr>
<td><em>Thanasimus undulatus</em> Say.</td>
<td>19</td>
<td>Rocky Mountains, northern British Columbia and Alberta; Great Slave Lake to Patricia, northern Quebec and New Brunswick.</td>
</tr>
</tbody>
</table>

## MELYRIDAE

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of samples</th>
<th>Geographical range of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Hoppingiana brevilabris</em> Blais. (Little jet beetle.)</td>
<td>51</td>
<td>British Columbia entire (except coastline) to Yukon, Great Bear Lake, and northern Manitoba (2 samples from Algoma, 1 from Gatineau River).</td>
</tr>
</tbody>
</table>

## COCCINELLIDAE—Lady-beetles

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of samples</th>
<th>Geographical range of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Hyperaspis undulata</em> Say.</td>
<td>1</td>
<td>Ontario.</td>
</tr>
<tr>
<td><em>Hyperaspis signata</em> binotata Say.</td>
<td>5</td>
<td>Ontario, Quebec.</td>
</tr>
<tr>
<td><em>Microweisea misella</em> Lec.</td>
<td>1</td>
<td>Northern British Columbia.</td>
</tr>
<tr>
<td><em>Scymnus phelpsii</em> Cr.</td>
<td>9</td>
<td>British Columbia entire, mainly coast.</td>
</tr>
<tr>
<td><em>Pysilobora vijintimaculata</em> Say.</td>
<td>2</td>
<td>British Columbia interior.</td>
</tr>
<tr>
<td><em>Pysilobora 20-maculata taedata</em> Say.</td>
<td>1</td>
<td>British Columbia coast northwards.</td>
</tr>
<tr>
<td><em>Ceratomegilla fuscilabris</em> Muls.</td>
<td>5</td>
<td>Ontario, New Brunswick, Prince Edward Island.</td>
</tr>
<tr>
<td><em>Hippodamia convergens</em> Guer.</td>
<td>5</td>
<td>Saskatchewan, Manitoba, Ontario, Quebec.</td>
</tr>
<tr>
<td><em>Hippodamia tibialis</em> Say.</td>
<td>4</td>
<td>Rocky Mountains, northern Saskatchewan, New Brunswick.</td>
</tr>
<tr>
<td><em>Hippodamia lunatomaculata apicalis</em> Csy.</td>
<td>1</td>
<td>Alberta.</td>
</tr>
<tr>
<td><em>(Three-banded lady-beetle.)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Coccinella trifasciata</em> L.</td>
<td>18</td>
<td>Ontario, Quebec, New Brunswick.</td>
</tr>
<tr>
<td><em>(Three-banded lady-beetle.)</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Coccinella trifasciata perpleza</em> Muls.</td>
<td>7</td>
<td>British Columbia interior, Ontario, Quebec.</td>
</tr>
<tr>
<td><em>Coccinella hieroglyphicus tricuspis</em> Kby.</td>
<td>1</td>
<td>British Columbia.</td>
</tr>
<tr>
<td><em>Coccinella monticola</em> Muls.</td>
<td>5</td>
<td>Ontario, Quebec.</td>
</tr>
<tr>
<td><em>Coccinella novemnotata</em> Hbst.</td>
<td>5</td>
<td>Quebec.</td>
</tr>
<tr>
<td>Species</td>
<td>No. of samples</td>
<td>Geographical range of samples</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>----------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Coccinella transversoguttata Fald. (Five-spotted lady-beetle.)</td>
<td>14</td>
<td>Peace River, Saskatchewan, Ontario, Quebec.</td>
</tr>
<tr>
<td>Coccinella quindecimnotata Kby.</td>
<td>2</td>
<td>Northwestern British Columbia and interior.</td>
</tr>
<tr>
<td>Coccinella undecimpunctata L.</td>
<td>1</td>
<td>Prince Edward Island.</td>
</tr>
<tr>
<td>Cycloneda munda Say.</td>
<td>1</td>
<td>British Columbia coast.</td>
</tr>
<tr>
<td>Cycloneda sanguinea L.</td>
<td>5</td>
<td>British Columbia coast.</td>
</tr>
<tr>
<td>Adalia disjuncta Rand.</td>
<td>12</td>
<td>Alberta, Saskatchewan, Ontario, Quebec.</td>
</tr>
<tr>
<td>Adalia bipunctata L.</td>
<td>5</td>
<td>British Columbia interior, Alberta, Quebec.</td>
</tr>
<tr>
<td>Adalia frigida L.</td>
<td>7</td>
<td>Northern and eastern British Columbia, Alberta, Ontario, Quebec.</td>
</tr>
<tr>
<td>Adalia frigida melanopleura Lec.</td>
<td>1</td>
<td>British Columbia interior.</td>
</tr>
<tr>
<td>Cleis picta Rand.</td>
<td>248</td>
<td>Great Slave Lake to James Bay, Anticosti and Cape Breton, south to United States border.</td>
</tr>
<tr>
<td>Cleis picta minor Csy.</td>
<td>68</td>
<td>British Columbia entire; Alberta northeast-wards to Lesser Slave Lake. (2 samples from Algoma.)</td>
</tr>
<tr>
<td>Cleis hudsonica Say.</td>
<td>4</td>
<td>British Columbia, Alberta.</td>
</tr>
<tr>
<td>Anisocadia duodecimmaculata Gebl. (Twelve-spotted lady-beetle.)</td>
<td>31</td>
<td>British Columbia interior; northern Saskatchewan to Anticosti and Nova Scotia, south to Ottawa River.</td>
</tr>
<tr>
<td>Anisocadia quatuordecimguttata L.</td>
<td>6</td>
<td>Manitoba, Ontario, Quebec, Nova Scotia.</td>
</tr>
<tr>
<td>Anatis mali Say.</td>
<td>140</td>
<td>Southern Rocky Mountains; southern Alberta and central Saskatchewan to Lake St. John and Maritimes, south to United States border.</td>
</tr>
<tr>
<td>Anatis quindecimpunctata Oliv.</td>
<td>6</td>
<td>Ontario, Quebec, New Brunswick.</td>
</tr>
<tr>
<td>Anatis rathvoni Lec.</td>
<td>2</td>
<td>British Columbia interior.</td>
</tr>
<tr>
<td>Neomysia subvittata Muls. (Tiger lady-beetle.)</td>
<td>76</td>
<td>Central Saskatchewan to Lake Abitibi, Gaspé and Nova Scotia, south to United States border.</td>
</tr>
<tr>
<td>Neomysia randalli Csy.</td>
<td>12</td>
<td>British Columbia, Alberta.</td>
</tr>
<tr>
<td>Neomysia montana Csy.</td>
<td>3</td>
<td>Rocky Mountains in British Columbia and Alberta.</td>
</tr>
<tr>
<td>Neomysia horni Cr.</td>
<td>1</td>
<td>British Columbia interior.</td>
</tr>
<tr>
<td>Chilocorus biulvnerus Muls. (Twice-stabbed lady-beetle.)</td>
<td>23</td>
<td>British Columbia entire, mainly interior; Alberta, Ontario, Quebec, and Maritimes.</td>
</tr>
</tbody>
</table>

### 20 ADDITIONAL SPECIES COMMONLY TAKEN FROM SPRUCE FOLIAGE

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>No. of samples</th>
<th>Range of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lampyridae</td>
<td>Lucilus corrucr L.</td>
<td>321</td>
<td>Southern Manitoba to Lake Nipigon, Lake Mistassini, Gaspé and New Brunswick south to Ottawa valley and Bay of Fundy.</td>
</tr>
<tr>
<td>Elateridae</td>
<td>Ludius propola Lec. (Two-barred click-beetle.)</td>
<td>273</td>
<td>Northern and interior British Columbia; central Saskatchewan to Lake Abitibi, Anticosti Island and Nova Scotia, south to United States border.</td>
</tr>
<tr>
<td>Elateridae</td>
<td>Ludius triundulatus Rand. (Three-barred click-beetle.)</td>
<td>236</td>
<td>British Columbia interior; Athabaska River to James Bay, Gulf of St. Lawrence and Cape Breton, south to United States border.</td>
</tr>
</tbody>
</table>
### 20 ADDITIONAL SPECIES COMMONLY TAKEN FROM SPRUCE FOLIAGE—Concluded

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of samples</th>
<th>Geographical range of samples</th>
</tr>
</thead>
</table>
| Curculionidae  
  *Hypomolyx piceus* DeG.  
  (Large spruce weevil.) | 193 | British Columbia interior to Yukon; Lake Athabaska to James Bay, Gulf of St. Lawrence and Maritimes, south to Muskoka. |
| Elateridae  
  *Ludius appropinquans* Rand.  
  (Inky click-beetle.) | 175 | Lake Athabaska to Lake Abitibi, Cote Nord, and Cape Breton, south to United States border. |
| Elateridae  
  *Agrionites limosus* Lec.  
  (Little brown click-beetle.) | 158 | Great Bear Lake and Lake Athabaska to northern Manitoba, Cote Nord and southern Newfoundland, south to Nova Scotia and Lake Ontario. |
| Cerambycidae  
  *Pogonocherus penicellatus* Lec.  
  (Little spruce sawyer.) | 85 | British Columbia interior, Yukon and Great Slave Lake to northern Manitoba, Lake Abitibi and Gaspé, south to Ottawa River and northern New Brunswick. |
| Cerambycidae  
  *Monochamus scutellatus* Say.  
  (Black sawyer.) | 81 | Yellowknife, N.W.T., to northern Manitoba, James Bay and Gulf of St. Lawrence, south to United States border. |
| Elateridae  
  *Ludius hieroglyphicus* Say.  
  (Egyptian click-beetle.) | 56 | British Columbia interior; southern Manitoba to Algoma, Gatineau River, Saguenay River, New Brunswick and Nova Scotia, south to Lake Erie. |
| Buprestidae  
  *Dicerca tenebrosa* Kby.  
  (Pine dieceria.) | 55 | Rocky Mountains; Great Slave Lake to Patricia, Lake St. John, Gaspé and New Brunswick, south to Ottawa River. |
| Elateridae  
  *Ludius medianus* Germ.  
  (Dun click-beetle.) | 52 | Lake Athabaska; Kenora to Algoma, Nipissing, Gatineau River, New Brunswick and Nova Scotia, south to Lake Ontario. |
| Buprestidae  
  *Buprestis maculativentris* Say.  
  (Flat-headed pine borer.) | 49 | Ontario, Quebec, New Brunswick. |
| Elateridae  
  *Ludius aratus* Lec.  
  (Furrowed click-beetle.) | 48 | Saskatchewan, Ontario, Quebec, Maritimes. |
| Elateridae  
  *Ludius spinosus* Lec.  
  (Nigger click-beetle.) | 39 | Ontario, Quebec, New Brunswick. |
| Chrysomelidae  
  *Syneta ferruginea* Germ.  
  (Rusty birch leaf-beetle.) | 35 | Lake Winnipegos to Lake Nipigon, Gatineau River, Cote Nord, southern Newfoundland, New Brunswick and Nova Scotia, south to Ottawa River. |
| Tenebrionidae  
  *Upis ceramoides* L.  
  (Forest darkling beetle.) | 32 | Northern British Columbia and Yukon; Lake Athabaska to Lake Nipigon, Abitibi and Lake St. John, south to Sault Ste. Marie and Ottawa River. |
| Heledidae  
  *Cyphon variabilis* Thumb.  
  (False flower-beetle.) | 27 | Yukon south to Cariboo and Rocky Mountains; northern Alberta to James Bay, south to Kenora, Nipissing and Montreal. |
KEYS

TENTHREDINIDAE—Sawflies

Smooth, shiny larvae with 6 or 7 pairs of ventral prolegs.

1. Seven pairs of ventral prolegs. 2
   Six pairs of ventral prolegs.
2. Head black, body olive with broad dark stripes. (Pl. Ia.)
   Head brown with black markings, body green with white stripes.
   Head brown with black markings, body green with white stripes. (Pl. IIc.)
   Neodiprion abietis
   Gilpinia polytoma
   Pikonema dimmockii
   Pikonema alaskensis
3. Head greenish, body green with white stripes. (Pl. IIa.)
   Head brown, body olive with darker stripes. (Pl. IIb.)
   (Head sometimes black, then recognized by paired dorsal hair-lines.)

PAMPHILIIDAE—False Webworms

Larvae lacking any ventral prolegs; pair of cerci on anal plate.

1. Body clear green with faint dorsal line, head greenish. Acantholyda sp.
   Body yellow-green to orange, with prominent dorsal, lateral and ventral stripes.
   Cephalcia sp.

LIPARIDAE—Tussock Moths

Larvae entirely covered with long, stiff, coloured hairs.

1. Dorsal tufts grey, body hairs black, white and grey. Olené plagiata
   Dorsal tufts yellow; two lateral black pencils present. (Pl. Ic.) Notolophus antiqua

PHALAENIDAE—Cutworms

Fairly large typical caterpillars with four pairs of ventral prolegs (occasionally only two).

1. Body grey-brown to black, with tufts of grey hairs arising from whitish bases (verrucae). (Pl. IIc.)
   Bodies smooth, with single primary setae only. Panthea acronyctoides 2
   (Pl. Ie.)
2. Larvae green with white stripes.
   Larvae with black and brown as dominant colours.
   Vermilion subspiracular line wholly or partially present. Feralia jocosa 4
   Vermilion line wanting; with white stripes only.
3. Two pairs of ventral prolegs. (Pl. IIf.)
   Autographa (spp. inseparable) 6
   Four pairs of ventral prolegs.
   Anomogyna elimata 7
4. Large, typical cutworms, up to 28 mm. long.
   Small forms, up to 14 mm. long.
   Anomogyna elimata
5. Segmental oblique black bars give dorsum a “herring-boned” appearance.
   Anomogyna perquiritata 8

7. Enlargement of abdominal segments I and VIII give larvae humped appearance.
   Larvae without humps or particular enlarged segments. 9
8. Head dark brown with light stripes; body grey, skin without granulations.
   Head light brown; body ruddy brown with dense minute granulations.
   Elphria versicolor 10
   Palthis angulalis
9. Body heavily mottled with black or ruddy brown.
   Body lightly mottled with brown; prominent dorsal and subdorsal stripes.
   Zanclognatha minoralis 10
10. Lateral margin of adfrontal sclerites markedly wavy. (Pl. IID.)
    Lateral margin of adfrontal sclerites nearly straight.
    Zanclognatha protumnusalis
    Epizeuxis americalis
    Anomogyna elimata
| 1. | Larva with segmental flap-like projections; colour red-brown. | Nemoria mimosaria | 2 |
| 2. | Larvae without flap-like projections; colours various. |  |
| 3. | Small, somewhat flattened larvae, reddish brown in colour. | Eupithecia palpata | 4 |
| 4. | Medium to large-sized, cylindrical larvae. (Pl. IIh.) | Eupithecia luteata |  |
| 5. | Midventrum light orange, lighter than ground colour. |  |
| 6. | Midventrum brown, darker than ground colour. |  |
| 7. | Larvae with banded appearance, due to colourless intersegments and ruddy segmental suffusion. | Hydromena divisaria | 5 |
| 8. | Larvae striped or patterned, without banded appearance. |  |
| 9. | Heads regularly marked with round black spots. | 15 |
| 10. | Heads not marked with round black spots. | 6 |
| 11. | Larvae green with longitudinal stripes. | 7 |
| 12. | Larvae grey or brown, patterned rather than striped. | 10 |
| 13. | White and yellow dorsal stripes. | 8 |
| 14. | Dark green dorsal stripes. | 9 |
| 15. | Body clear green, subdorsal lines greenish-white, head clear green. | Nyctobia limitaria |  |
| 16. | Body yellow green, subdorsal and addorsal lines yellow, head with yellow bar on cheek. | Eufidonia notata |  |
| 17. | Subventral stripe uniform green. | Semiothisa weeni |  |
| 18. | Subventral stripe dark grey. | Semiothisa granitata |  |
| 20. | Body with tubercles, swellings or ridges. |  |
| 21. | Body with tubercles only. | 12 |
| 22. | Body with swellings or ridges, as well as tubercles. | 14 |
| 23. | Head deeply cleft, vertex peaked on either side. (Pl. IIm.) | Pero morrisonarius | 13 |
| 24. | Head normal, vertex rounded. |  |
| 25. | Small larvae with dark interrupted dorsal line, full-grown in spring. | Protoboarmia porcelainia |  |
| 26. | Large larvae without dorsal line, full-grown in autumn. | Caripeta divisata |  |
| 27. | Light spots on sides, black transverse ridge on 8th abdominal segment. | Ectropis crepuscularia |  |
| 28. | No light spots on body, black middorsal line on last three segments. | Tetracis lorata |  |
| 29. | Four black spots on dorsum of each abdominal segment. (Pl. IIm.) | Ellopia fiscellaria | 16 |
| 30. | Dorsum with longitudinal stripes but without spots. |  |
| 31. | Longitudinal paired lines are black and heavy; ground colour pale. | Cingilia catenaria |  |
| 32. | Longitudinal paired lines are weak; ground colour green or crimson. | Nepytia canosaria |  |

**PYRALIDAE, OLETHREUTIDAE AND TORTRICIDAE**

Small, smooth, supple and wormlike larvae with four pairs of ventral prolegs, silk-spinners.

| 1. | Larvae with body-colour clear green. | Peronea varians | 2 |
| 2. | Larvae coloured brown, black or reddish-brown. | 5 |
| 3. | Head, and margins of prothoracic shield, black-brown. | Taniva albolineana | 3 |
| 4. | Head and prothoracic shield mainly green. |  |
| 5. | Head green, overlaid with light brown, without markings. | 4 |
| 6. | Head green with definite brown or black markings. |  |
| 7. | Eight ventral stripes running down vertex. (Pl. IIq.) | Argyrotaenia lutosana | 6 |
| 8. | Vertex unmarked, black marks in ocellar area and at angle of jaw. (Pl. IIo.) | Tortrix packardiana |  |
| 9. | Four conspicuous round white setiferous plaques on each segment. |  |
| 10. | Setiferous plaques inconspicuous; body with longitudinal stripes. | 8 |
PYRALIDAE, OLETHREUTIDAE AND TORTRICIDAE—Concluded

6. Head and body reddish-yellow to honey-yellow. Zeiraphera ratzeburgiana
   Head black or brown, body brown with olive suffusion.

7. Prothorax partly or wholly sclerotized; anal plate paler in colour, pale
   lateral stripe conspicuous. Cacoecia fumiferana
   Prothorax pale, not sclerotized; anal plate of ground colour, without
   conspicuous lateral stripe. Amorbia humerosana

8. Head and prothorax light brown; five narrow dark dorsal stripes.
   (Pl. II.) Hercilia thymetusalis
   Head black-brown, prothorax pale; dorsum tan, subdorsal bands broad
   and black. Shoot form of Dioryctria reniculella

PENTATOMIDAE—Soldier Bugs and Stink Bugs

Bugs roughly pentagonal in shape, the wings overlapping, and with five antennal segments.
(Adapted from G. S. Walley—unpublished.)

1. Tarsi two-segmented; sternum with distinct longitudinal keel.
   Tarsi three-segmented; sternum without a keel.
   Orifices of metasternum short and broadly rounded. Meadorus lateralis
   Orifices of metasternum long and narrow; dorsum with a red cross.
   Eiasmastethus cruciatus

2. First segment of beak largely imbedded between the large bucculae.
   First segment of beak largely free, bucculae small.

3. Blunt median ventral tubercle on first abdominal segment; pronotum
   Ventral tubercle wanting; pronotum never greenish.
   usually greenish. Banasa dimidiata
   Euschistus tristigmus

4. Tylus as long as juga; median row of black spots under abdomen.
   Tylus distinctly shorter than juga; median row of spots lacking.
   (Pl. II.) Euschistus euschistoides

5. Second joint of antenna one-third longer than third; femora with numerous
   purple dots; length 11 mm. or more; darker form. (Pl. IIr.) Podisus serieventris
   Second joint of antenna only one-fourth longer than third; femora without
   purple dots; length 10 mm. or less; lighter form. Podisus modestus

CERCOPIDAE AND FULGORIDAE—Spittle Bugs and Lantern Bugs

Bugs with wings held sloping at sides; nymphs (of Cercopidae) secreting white froth.
(Adapted from Stearns, in Britton, 1923; and Osborn, 1938.)

1. Antennae inserted between eyes; anterior margin of pronotum angulate.
   Antenna inserted below eyes, on sides of head.

2. Front of head inflated and produced, nearly at right angles with vertex.
   Front scarcely inflated, flattened convex, at acute angles with vertex.

3. Head narrow, elongate; apex of elytra blunt. (Pl. III.) Aphrophora parallela
   Head broad, short; apex of elytra sharp. Aphrophora permutata

4. Colour deep fulvous, light bands across elytra, and light median stripe
   Colour varying ochraceous, light bands and stripes obscure or wanting.
   atop head. Aphrophora saratogensis
   Aphrophora signoreti

5. Elytra, when folded, overlapping at apex.
   Elytra not overlapping at apex, fuscous on basal third only.

6. Face black, with distinct white cross-band.
   Face without distinct white cross-band.

7. Vertex very short, broader than long.
   Vertex as long as broad.
APHIIDAE—Aphids

Pear-shaped, soft-bodied insects with delicate wings.
(Adapted from Gillette and Palmer, 1931; and Hottes and Frison, 1931.)

1. Rostrum of beak acute; radial sector of forewing arising from stigma. (Pl. IIu.) Cinara spp.
   Rostrum obtuse, radial sector arising proximal of stigma. (Pl. Ik.) Mindarus abietinus

ADELCIDAE—Gall Aphids

Aphids recognized mainly by the type of gall made on the growing shoots of spruce.
(Adapted from Patch, 1909; and Annand, 1928.)

1. Galls not terminal—"pineapple galls." (Pl. Im.)
   Galls terminal, occupying tip of or entire shoot. 2

2. Gall aphids with media of hind wing almost at right angles to radial sector. (Pl. IIu.)
   Gall aphids with media of hind wing at an acute angle with radial sector. Adelges abietis
   Adelges lariciatus

3. Gall sufficiently resembling a cone to be mistaken for one.
   Galls recognizable as deformed shoots. Pineus pinifoliae 4

4. Gall a ragged and deformed shoot, needles not much shortened.
   Galls usually well-formed. Pineus similis 5

5. Needles much shortened, small, compact and roundish gall.
   Needles not much shortened. Adelges strobilobius 6

6. On black and red spruce, galls up to 1½” long.
   On blue spruce, galls up to 2¼” long and curved downwards. Pineus floccus
   Adelges cooleyi

COCCIDAE—Scales

Small insects sometimes naked, sometimes living beneath a scale. Legs and antennae usually not visible with the naked eye.

1. Globular brown scale at bases of shoots.
   White shell-like scale on surface of needles. (Pl. In.) Physokermes piceae
   Phenacaspis pinifoliae
Plate I

a. Sawflies—Tenthredinidae (example Neodiprion abietis).
b. False Webworms—Pamphiliidae.
c. Tussock Moths—Liparidae (example Notolophus antiqua).
d. Noctuids—Phalaenidae.
e. Loopers—Geometridae.
f. Snout Moths—Pyralidae (example Dioryctria reniculella).
g. Soldier Bugs—Pentatomidae.
h. Spittle Bugs—Cercopidae.
i. Lantern Bugs—Fulgoridae (example Epiprocta slossoni).
j. Aphids—Aphiidae (example Mindarus abietinus).
k. Work of Gall Aphids—Adelgidae (example Adelges abietis).

m. Scales—Coccidae (example Phenacaspis pinifoliae).

a, c, d, e & f after illustrations by R. G. Calvert; b after Yuasa, g after Hickman, h after Stearns, j after Sim, m after Patch, and n after de Gryse.
Plate II

a. Pikonema dimmockii. Frontal view of head.
c. Diplion polytomum. Frontal view of head.
d. Zanclognatha protunnusalis. Frontal view of head showing adfrontals.
f. Autographa sp. Lateral view showing two pairs of ventral prolegs.
g. Elaphria versicolor. Lateral view.
h. Eupithecia palpata. Lateral view.
i. Protoboarmia porcelaria. Dorsal view of mid-section of abdomen.
k. Pero morrisonarius. Frontal view of head.
l. Tortrix packardiana. Lateral view of head.
m. Herculia thymetusalis. Dorsal view of mid-section of abdomen.

q. Argyrotanaeia lutosana. Lateral view of head.
r. Podisus seriecentris. Ventral view showing beak and bucculae.
s. Euschistus euschistoides. Dorsal view showing tylus and juga.
t. Aphrophora parallela. Dorsal view of head and prothorax.
u. Cinara sp. Wing of alate viviparous form.
OTTAWA: Printed by EDMOND CLOUTIER, Printer to the King's Most Excellent Majesty, 1941.
SCIENCE SERVICE

Director
J. M. Swaine, Ph.D., F.R.S.C.

Associate Directors
Arthur Gibson, LL.D., F.R.S.C.
H. T. Güssow, LL.D., F.R.S.C.

Assistant Director
E. A. Watson, V.S.

Assistant to Director
H. L. Trueman, B.S.A.

Chiefs of Divisions

Entomology ........................................... Arthur Gibson, LL.D.
Botany and Plant Pathology ..................... H. T. Güssow, LL.D.
Animal Pathology ................................. E. A. Watson, V.S.
Chemistry ............................................ C. H. Robinson, B.A.
Bacteriology and Dairy Research ............. A. G. Lochhead, Ph.D.