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Insects of Eastern Larch, Cedar and Juniper

A. H. Rose, O. H. Lindquist and K. L. Nystrom

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Insectes des pins de l'est du Canada

Insects of Eastern Spruces, Fir and Hemlock
Insectes des épinettes, du sapin et de la pruche de l'est du Canada

Insects of Eastern Hardwood Trees
Insectes des feuillus de l'est du Canada

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Abstract

This handbook is designed to enable people interested in trees to identify insects causing damage to them. All insect species or groups that have caused damage to larch, cedar and juniper in Canada east of the Rocky Mountains are included. About 85 species are treated and of these 47 are found on larch, 22 on cedar and 16 on juniper. The insect and/or its damage can be identified by means of keys using non-technical language along with about 150 color illustrations. Biological sketches of the insect are given, and the need for control measures, along with the timing of application, is prescribed. Common names of insects are used generally, but the scientific names are also given in the text.

Résumé

Ce guide a été conçu pour aider les gens qui portent intérêt aux arbres à identifier les insectes qui les endommagent. Il comprend toutes les espèces d'insectes ou groupes d'insectes qui ont endommagé le mélèze, le thuya et le genévrier du Canada à l'est des Rocheuses. Les auteurs étudient environ 85 espèces, dont 47 se retrouvent sur le mélèze, 22 sur le thuya et 16 sur le genévrier. Des clés, rédigées dans une langue non technique, permettent d'identifier l'insecte ou ses dégâts, et cette identité peut être confirmée par quelque 150 illustrations en couleurs. Le texte fait en outre la description biologique sommaire de l'insecte et mentionne les mesures de lutte éventuelles, y compris le moment propice pour les interventions. En général, les auteurs identifient les insectes par leur nom commun, mais le nom scientifique (latin) est aussi donné dans le texte.

Foreword to the 1980 Edition

This is the third in a series of handbooks that is capturing the attention of forest managers, pest extension people and those of the general public interested in the maintenance of healthy trees. This publication completes coverage of the major insects of coniferous trees in eastern Canada. As in *Insects of Eastern Pines* and *Insects of Eastern Spruces, Fir and Hemlock*, much information was drawn from the database developed over many years by the former Forest Insect and Disease Survey. Particular mention again is made of contributing specialists at the Canadian Forest Service regional establishments across the country, taxonomists at the Biological Resources Division, Centre for Land and Biological Resources Research (formerly the Biosystematics Research Institute), Agriculture and Agri-Food Canada, Ottawa, and dedicated field and laboratory staff of the Survey. The authors continue to challenge the task of preparing and presenting an enormous amount of information in a concise, attractive and useful form.

W. L. Sippell
Program Manager
Entomology and Pathology

Foreword to the 2000 Edition

This handbook and others in the *Insects of…* series came about because of the dedication of numerous staff who worked at the Great Lakes Forestry Centre: the late Art Rose, Research Scientist, and O.H. Lindquist, senior technician, whose dream it was to complete this series and to offer an educational and scientifically useful book to entomologists, foresters and people in general interested in insects and trees; the field staff who collected the insects, gathered the biological information and provided much of the photographic material; the taxonomists from the National Identification Service, Eastern Cereal and Oilseed Research Centre, Agriculture and Agri-Food Canada, who identified or confirmed collections of insects; and contributing research scientists at other Canadian Forest Service centres.

This handbook was written for the scientist but also for those interested in trees and the insects that can be found feeding on them. About 85 species of insects and mites are included in this handbook along with biological information and general advice on control. Not all insects and mites found on larch, cedar or juniper are included but those that are have caused noticeable damage at one time or another. Easy to use keys and photographs of most of the insects and mites assist in identification.

Revisions of the handbooks in the *Insects of…* series occur from time to time to keep abreast of new scientific knowledge regarding insect name changes, biological information, distribution records and control of pests.

Kathryn Nystrom
Insect Identification Officer
Canadian Forest Service, Sault Ste. Marie

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Eastern larch

Eastern white-cedar

Common juniper

Eastern redcedar

Creeping juniper

Introduction

This handbook completes the series dealing with the insects of conifers in central and eastern Canada and adjacent areas of the United States. Earlier handbooks in this series published by the Canadian Forest Service are *Insects of Eastern Spruces, Fir and Hemlock*, Forestry Technical Report 23 (revised in 1994); *Insects of Eastern Hardwood Trees*, Forestry Technical Report 29 (revised in 1997); and *Insects of Eastern Pines*, Publication 1313 (revised in 1999). Information for this edition, like the others, was drawn mainly from data and material accumulated over a 50-year period by the former Forest Insect and Disease Survey in Ontario, now known as the Forest Health Monitoring Unit. However, additional information has been drawn from reports and publications of Forest Health Monitoring Units in other provinces as well as from the entomological literature. All insects that have caused injury in the past are included, and about 85 species or species groups are treated.

The format of this handbook differs from the earlier ones as shown in the Contents. In this text, it was found necessary to treat each species of tree separately because the insect complex on each one is for the most part different. However, where insects feed on more than one tree species they are included in each appropriate key, and the reader is referred to a single write-up in one of the sections. Keys are used to facilitate the identification of insects or insect injury, and biological information is provided for all species. For some species it was not possible to provide information on the seasonal occurrence of various stages over broad areas. However, Ontario data, usually given, may be used as a guide for other areas. References in the text to color illustrations are indicated by the symbol ▭. For the identification of any insect on larch, cedar or juniper not treated here, a representative sample of living specimens and damage should be forwarded to the Forest Health Monitoring Unit at the Canadian Forest Service centre serving your area listed on page 12.

Injury

Injury to trees can be caused by such varied factors as climate, insects, mites, diseases, birds and mammals. Humans often cause injury by mechanical means or by adversely altering the tree's environment either above or below ground. With a few exceptions, this handbook deals with problems created by insects or mites.

All parts of a tree are subject to attack by some insect species. The degree of injury inflicted, however, depends on the number of insects, type of feeding, time of year and how vital to survival is the part attacked.

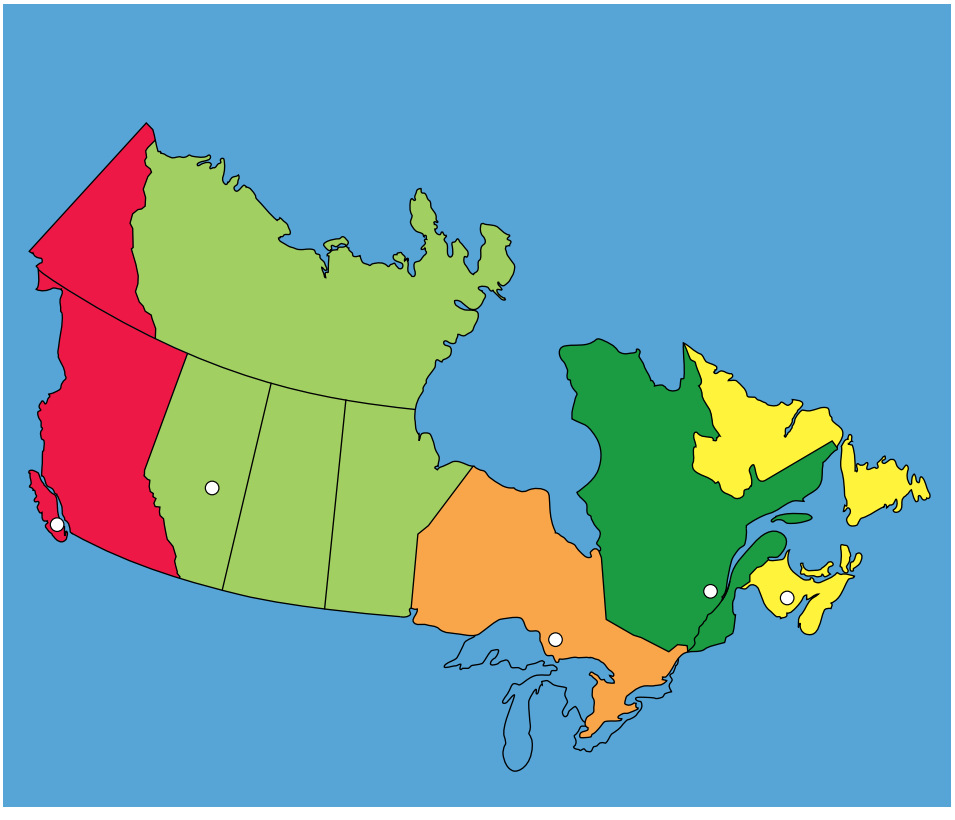
Control

Because the kinds of pesticide that may be used are constantly changing as unacceptable side effects are discovered, no specific control measures are given in this handbook.

However, the necessity for control and the stages in the pest's life cycle most susceptible to control measures are indicated. Also, to facilitate selection, the required type of pesticide (contact, stomach, systemic or fumigant) is given. In addition, other methods that place greater emphasis on biological control or are more selective and less deleterious to the environment may be proposed. Information on currently registered pesticides may be obtained from various government agencies and is available also on the label of the pesticide container. The pesticide used should be nontoxic to the targeted tree. If large-scale chemical control measures are necessary, the advice of a specialist should be obtained.

Further Reading

Historical information on important or noteworthy forest insects in Canada may be found in publications produced by the Canadian Forest Service, Natural Resources Canada. These include annual reports of the Forest Health Monitoring Units; a four-volume report, *Forest Lepidoptera of Canada* (1958–1965); *Insects Harmful to Forest Trees*, by R. Martineau, 1984; and *Forest Insect Pests in Canada*, by J.A. Armstrong and W.G.H. Ives, editors, 1995. *Insects of Eastern Forests*, by A.T. Drooz, editor, 1985, Miscellaneous Publication 1426 of the Forest Service of the United States Department of Agriculture, is a comprehensive treatment of forest insects and contains an extensive list of papers in entomology journals. We also recommend *Insects That Feed on Trees and Shrubs*, by W.T. Johnson and H.H. Lyon, 1976, Cornell University Press, and *Trees in Canada*, by J.L. Farrar, 1995, Canadian Forest Service, Natural Resources Canada/Fitzhenry & Whiteside Limited. For a further investigation into the insects that affect seeds and cones of larch and other conifers, we recommend *Management of Insect Pests of Cones in Seed Orchards in Eastern Canada*, by J.J. Turgeon and P. de Groot, 1992, Ontario Ministry of Natural Resources/Forestry Canada. A specialist in forest entomology should be consulted for more detailed information.



Forestry Centres

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Eastern larch

Larch in winter

Larch in fall

Male cone

Female cone

The distribution of eastern larch, *Larix laricina* (Du Roi) K. Koch, also called tamarack and hackmatack depending on where you live, extends from the Mackenzie River Valley east to the Atlantic Ocean. Formerly, the wood was used extensively because of its resistance to decay, but for various reasons its use has declined greatly. Members of this genus, unlike the other conifers that retain their needles for several years, drop their needles annually. Late in the fall, after the broadleaved trees have lost their foliage, larch needles turn yellow and are usually shed before much snow has fallen. Introduced species, of European and Asian origin, are commonly planted in reforestation programs. They can be readily distinguished from the native species by their larger cone: cones of eastern larch are about 12 mm long.

Some shoots on larch are elongated, but most are dwarf. Needles on elongated shoots are arranged in a long spiral, whereas

Elongated and dwarf shoots

New cone

Open cone

Eastern white-cedar

those on dwarf shoots are in dense whorls. In the spring, needles on dwarf shoots are well developed before the elongating shoots become evident. The dark brown buds are located at the tip and along the side of elongated shoots, and at the tip of dwarf shoots. The male and female cones also arise on dwarf shoots. The new cones mature and shed their seed in the year of development. The open cones remain on the tree over winter.

Eastern white-cedar, *Thuja occidentalis* L., often called eastern arborvitae, especially when it is used as an ornamental, occurs from Manitoba to New Brunswick and in parts of Nova Scotia. There are many forms of cedar including pyramidal, globose and pendulous ones that have been cultivated for ornamental purposes. Cedar wood is soft, light and resistant to decay. There are three leaf shapes. Two of these are short and wide and are arranged in

Ornamental eastern white-cedar

opposite pairs clasping the shoots to form flat fan-shaped sprays of foliage. The third shape is long and narrow and is found on vigorous shoots: in succeeding years these leaves turn brown and are cast off, leaving the orange-brown twig exposed. The inconspicuous male and female cones are located at the tip of the shoots. The pale green immature cones ▭ begin to mature by midsummer, turn brown by fall and remain on the tree over winter. The seeds are shed by the mature cones ▭ beginning in late summer and may continue throughout the winter and even into the following spring.

Leaf shapes

Immature cones

Mature cones begin to shed seeds in late summer

Juniper

There are three kinds of junipers in the *Juniperus* L. genus in eastern Canada. Two are widely distributed shrubs. The common juniper of abandoned farms, having prickly needles with a white upper surface , is better known than the creeping juniper, which has soft needles and is found mainly on sandy or rocky soil. The third juniper, generally called eastern redcedar, *Juniperus virginiana* L., is a small tree. In Canada, it has a limited distribution, mostly in Ontario with small pockets in Quebec, and grows best in soils of limestone origin. Junipers have two kinds of leaves: scale-like leaves that are arranged in four rows covering the twigs to form four-sided branchlets, and needle-like leaves that are near the tip of vigorous shoots. Unlike most other conifers, junipers usually bear their male and female cones on different trees. The male cones of junipers , , arise at the tips of branchlets. The fruit, initially pale green with a white bloom but turning blue-black as it ripens, is berry-like and requires one to three seasons before the seeds mature. Many forms of eastern redcedar have been cultivated for ornamental plantings.

Common juniper leaves

Eastern redcedar mature scale-like leaves

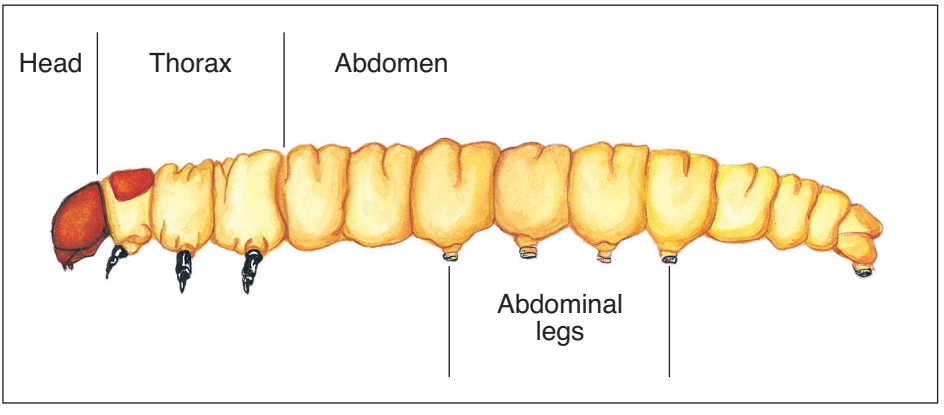
Common juniper male cones

Eastern redcedar male cones

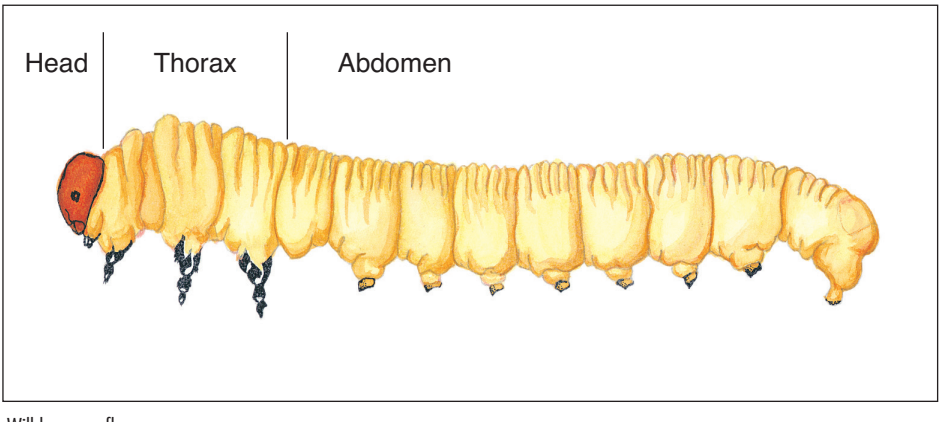
Eastern redcedar fruit

Eastern redcedar juvenile needle-like leaves

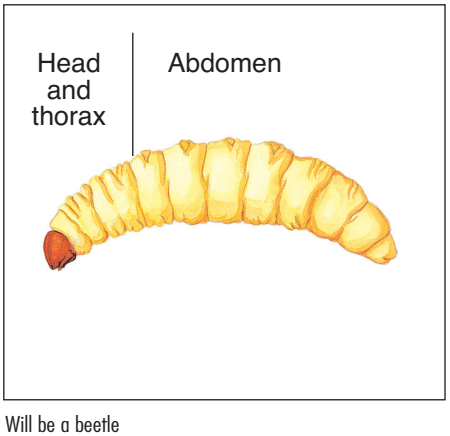
Types of insects



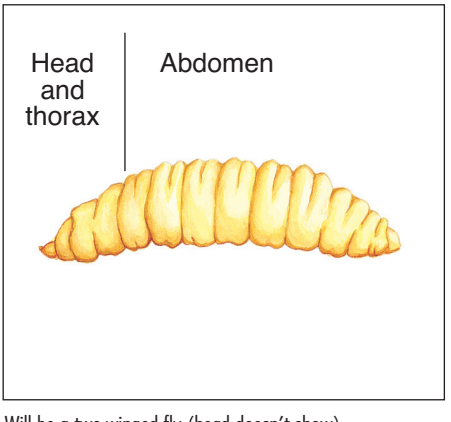
Will be a moth



Will be a sawfly



Will be a beetle



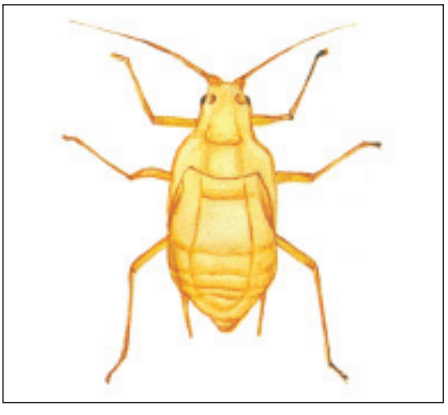
Will be a two-winged fly (head doesn't show)

Most of our destructive forest insects develop in four stages—egg, larva, pupa and adult—each distinctly different from the other. The larva, sometimes referred to as "caterpillar," "worm," "grub" or "maggot," is the principal feeding stage. It sheds its skin at intervals as it grows, from the tiny individual that emerges from the egg to the full-grown larva. The pupa is an inactive transformation stage between the feeding larva and the reproducing adult. Larvae, particularly those destined to become moths, vary greatly in color, shape and size, and may be hairy or naked. Most of our forest insects can be grouped according to the general structure of the larvae as illustrated in the simplified outline drawings .

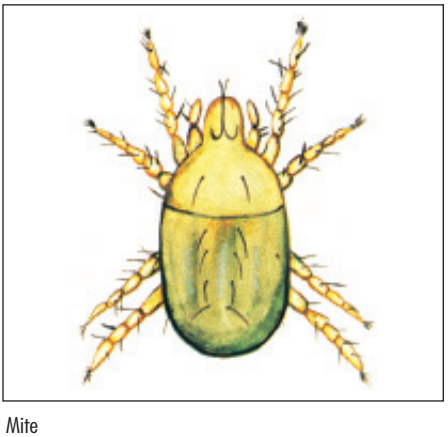
A few of our forest insects have only three stages—egg, nymph and adult. In this type of development, the nymph also sheds its skin at intervals as it grows, but, unlike the larva, it resembles the adult and does not require a pupal stage in which to change to an adult insect.

Since adults of most injurious insects discussed in this handbook are seldom seen, they are not included here. Several of them, however, are illustrated elsewhere.

The mites , minute relatives of spiders, are not technically insects, since the adults have either two or four pairs of legs, whereas insect adults have three pairs of legs. Young mites generally resemble the adult and there is no pupal stage.



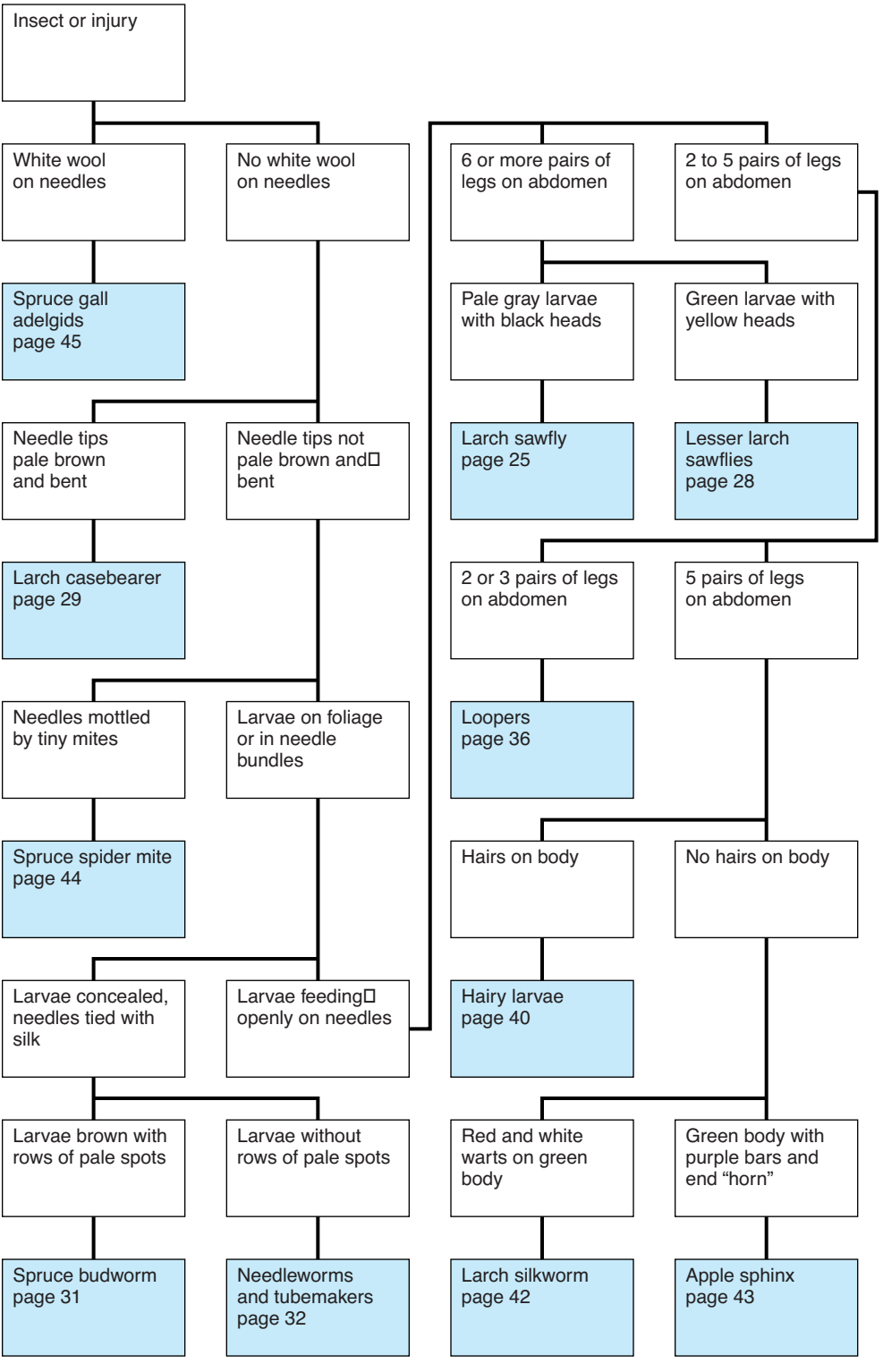
Aphid nymph



Mite

LARCH — NEEDLE

Larch—needle



Larch sawfly

The larch sawfly, *Pristiphora erichsonii* (Hartig), is a serious pest of larch in North America. Its origin has been debated by entomologists for many years. However, intensive studies now indicate several strains, some native and others introduced. Epidemics occur periodically across Canada and the northern United States, and the absence of mature stands is often attributed to tree mortality caused by past infestations of this pest. The larvae feed on the needles of native and exotic European, Japanese and Siberian larches. The adult sawflies display a remarkable ability to find isolated ornamental trees far removed from stands of larch.

There is one generation each year and full-grown larvae overwinter in cocoons in the ground. In spring or summer, the larvae change to pupae, although a small proportion of the population may remain as larvae in their cocoons for two or three winters. The pupae change to adult sawflies over an extended period from May to August, depending on site and climatic conditions. Males seldom exceed 2 percent of the adult population, and reproduction for the most part occurs without fertilization of the female.

The average number of eggs laid by a female is about 75. Usually 10–30 eggs are laid in any one shoot, in a double row of slits cut along one side of the elongating shoot . When egg slits are cut early in the growing season, the shoots tend to curl in a characteristic manner . The larvae are grayish with black heads. They feed

Adult larch sawfly (6X)

Sawfly eggs in shoot

Curled shoot

Mature larva of larch sawfly

Cocoon

Colony of larvae

in groups from June to September, stripping the needle clusters from whole branches and often from the entire tree. When full grown and about 20 mm long, the larvae drop to the ground and spin tough, oval silken cocoons in the litter where they overwinter.

Populations of the larch sawfly are regulated by many natural factors including parasites, predators, disease and flooding of cocoon sites. The predator *Apateticus bracteatus* (Fitch) is one of several stink bugs preying on larvae, and a species of the fungus *Entomophthora* causes the death of others . Shrews and voles are important predators during the cocoon stage. In fact, shrews have been introduced into Newfoundland to improve the natural control of the sawfly there. Elsewhere in Canada, several parasites have been introduced from Europe with some success in regulating sawfly populations. Chemical controls are registered for use against this sawfly and if used should be applied against the young feeding larvae as they appear througout the summer. Other methods of control include monitoring susceptible trees and removing larvae by hand.

Stink bug predator

Larch sawfly larva killed by fungus

Lesser larch sawflies

Threelined larch sawfly larva

The lesser larch sawflies of the genus *Anoplonyx* occur from Alberta to Newfoundland and in the northeastern United States. There are two species in this area: the threelined larch sawfly, *Anoplonyx luteipes* (Cresson), is the common one, and the onelined larch sawfly, *A. canadensis* Harrington, is found less often. No serious injury to larch by the larvae of these sawflies has been recorded.

The adults emerge from overwintering cocoons in the spring and the females lay their eggs, usually singly, in the needles. The larvae tend to be solitary feeders and may be found on the foliage from about mid-June to early October. The larvae of the two species are similar in color and markings except *A. luteipes* has three, often indistinct, grayish lines on each side of the body, whereas *A. canadensis* has one lateral line on each side. When full grown the larvae are about 13 mm long. They overwinter in cocoons in the soil and change to pupae in the spring.

No control measures have been required for these insects.

Larch casebearer

Damaged needles

The larch casebearer, *Coleophora laricella* (Hübner), is an introduced pest that was first found on this continent in the 1880s and now occurs from Newfoundland and the Maritime provinces to southeastern Manitoba. It is also found in the Rocky Mountain region of southern British Columbia and across the border in adjacent areas of the United States. It is often a serious defoliator of both native and exotic species of larch. When the insect is abundant, needlemining by the larvae causes the tips of needles to bend and turn light brown ▭.

Adult larch casebearer

Larch casebearer adults ▭ are tiny moths that fly from late May to August. The eggs are laid on the needles and hatching occurs in 2 weeks. The larvae bore into the needles, which they mine until late summer. At this time the larva lines a hollowed portion of the needle with silk and then chews the section free at both ends. The resulting case ▭ becomes a portable shelter for the rest of the larval period. In feeding, the larva fastens the fore-end of the case to a needle, which it then mines as far as it can reach. Winter is spent in the case, which is fastened with silk to a twig, usually at the base of a bud. Feeding is resumed in early spring when the new needles appear, and more needles are mined for three to four weeks. The larva changes to a pupa in the case which soon changes to a moth to complete the life cycle.

Larval cases

Several species of parasites have been imported from Europe to combat the larch casebearer, and two of these, *Agathis pumila* (Ratzeburg) and *Chrysocharis laricinellae* (Ratzeburg), are now widely established on this continent. These two species are believed to be the causes of the reduction in outbreak severity in eastern North America. If chemical control is necessary, a contact insecticide is registered for controlling larch casebearer and should be applied in early spring.

Spruce budworm

Full-grown spruce budworm larva

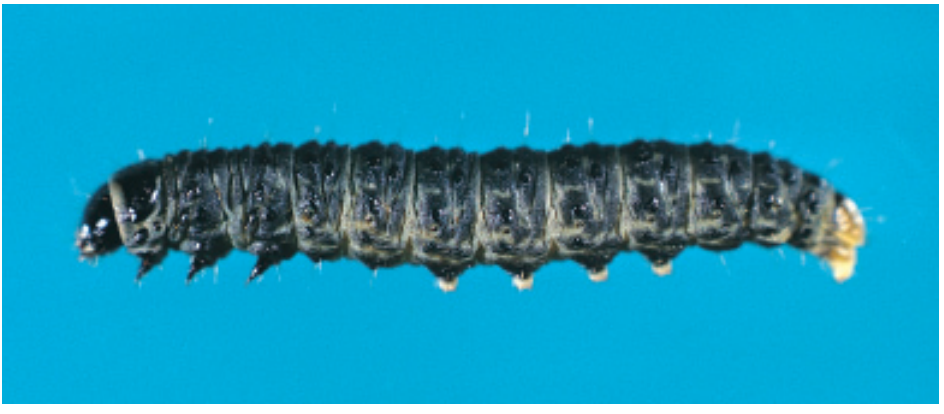
The spruce budworm, *Choristoneura fumiferana* (Clemens), is a highly destructive pest in the spruce–fir forests of North America. When large numbers are present, severe feeding damage also occurs on other conifers such as larch.

The larvae feed on the needles from early spring to July, usually spinning fine silk about the needles. When the larva is full grown and about 22 mm long, it changes to a pupa on the foliage. The gray to reddish moths fly from late June to early August. Further information on this insect may be found in *Insects of Eastern Spruces, Fir and Hemlock*.

Although several contact and stomach insecticides are registered for use against the spruce budworm, a biological insecticide is environmentally safer. It is best to use any of these insecticides when the larvae are small.

Damaged needles

Needleworms and tubemakers



Larch needleworm

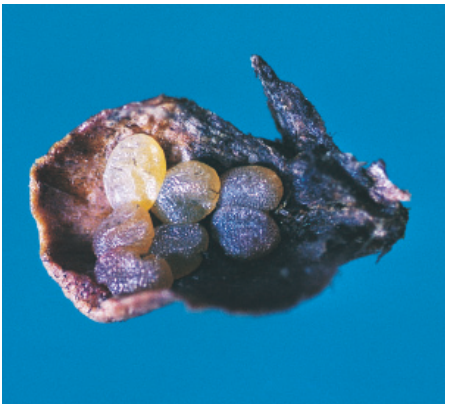
Brown larch tubemaker

Orange larch tubemaker

Larvae dusky ..... Larch needleworm
Larvae brown ..... Brown larch tubemaker
Larvae orange ..... Orange larch tubemaker

The larch needleworm, *Zeiraphera improbana* (Walker), is distributed across southern Canada and the northern United States. It is usually present in low numbers, but occasional epidemics, usually of short duration, have occurred on native larch in Newfoundland, Quebec, Ontario and British Columbia. Although larch is the primary host, young spruce understory trees may also be severely defoliated.

The needleworm adults, small dark gray moths, are in flight during July or August in Ontario. The eggs are usually laid in clusters deep in the current year's cones, where they overwinter. The eggs hatch and the young larvae begin feeding in late April or May, when the new needle clusters on dwarf twigs are about 3 mm long. The larvae, cream with black heads, feed singly and are later found in clusters of needles tied with silk to form compact tubes . When the larvae are full grown , usually in July, they are dusky blackish and about 14 mm long. They hide in ragged shelters of dead needles tied with silk (see Needles damaged, page 34) along the twig from which they feed on nearby foliage. These larvae soon drop from the trees and change to pupae in silk-lined cocoons in the ground litter. The adults emerge later in summer.



Larch needleworm eggs

Early larva in tube

Needles damaged by larch needleworm

Brown larch tubemaker in tube of needles

Brown larch tubemaker pupa in tube

Because infestations of the larch needleworm have been short-lived, no large-scale control measures have been required. However, a contact or stomach insecticide, applied when new needles appear, should be effective against this pest. In Ontario, a braconid parasite from the genus *Clinocentrus* is apparently an important biological control agent.

The brown larch tubemaker, also known as the eyespotted bud moth, *Spilonota ocellana* (Denis & Schiffermüller), is probably an introduced species. It is found from coast to coast in the northern United States and south to North Carolina, and from the Great Lakes to the Atlantic seaboard in Canada. In southern Ontario, it is often found in plantations of European larch. Because serious injury has not been recorded, control measures have not been required.

In Ontario, the gray-patterned moths fly in June and lay their eggs on the undersides of leaves. After hatching, the young larvae feed for a short time on leaves, after which they migrate to twigs where they spin hibernacula and overwinter. The larvae resume feeding in the spring on opening buds and unfolding leaves, which they bind together with silk . They are full grown (see page 32) when they are about 12 mm long. The larvae change to pupae in the tubes of needles on the trees from May to mid-June.

The orange larch tubemaker, *Coleotechnites laricis* (Freeman), is a relatively new species

Orange larch tubemaker pupa exposed in tube

Empty pupal case

to science. It was described and named from Ontario specimens in 1965. The larvae have been found only in small numbers in various parts of Ontario.

In its adult stage, the tubemaker is a tiny moth that usually flies in early summer. The eggs are laid on or near the foliage. On hatching, the larvae tunnel into needles where they feed until the fall. At the onset of cold weather the larvae hibernate in shelters of a few needles and excreta tied along the twig. In the spring, they tie clusters of needles together to form bundles or tubes in which they complete their feeding, usually by mid-June. The full-grown larva  (see page 32) is about 8 mm long. It changes to a dark-colored pupa  in the final feeding tube or in a newly constructed one. When the moth emerges, the empty pupal case typically protrudes from the tube  .

No control measures have been required to date.

Loopers

Many kinds of loopers occur on larch in eastern Canada, but they are usually found singly or in small numbers and no serious injury is recorded. Most species are general feeders on a variety of coniferous and deciduous trees. Five of the more common ones that feed on larch are illustrated.

The green larch looper, *Semiothisa sexmaculata* (Packard), is found from eastern British Columbia to Newfoundland throughout most of the range of larch. The larvae feed in July, August and September, and have a light  and a dark color phase  . When full grown and about 18 mm long, they drop to the ground, where they change to pupae and overwinter in the soil. The closely related species *S. oweni* (Swett) and *S. signaria dispuncta* (Walker) also occur on larch.

The hemlock looper  , *Lambdina fiscellaria* (Guenée), is a serious pest of balsam fir and hemlock from Ontario to Newfoundland and in the northeastern United States. It is a general feeder and has been reported to defoliate larch. The larvae feed from June to September, but mainly in July, and attain a length of about 30 mm. Detailed information on this species may be found in *Insects of Eastern Spruces, Fir and Hemlock*.

The saddleback looper  , *Ectropis crepuscularia* (Denis and Schiffermüller), is another general feeder. Although of no consequence in central and eastern Canada, it has occasionally caused tree mortality to western hemlock and

Green larch looper (light phase)

Green larch looper (dark phase)

Hemlock looper

Saddleback looper

other coniferous and deciduous trees in British Columbia. The larvae feed from June to September and are about 32 mm long when full grown. This insect overwinters as a pupa in the soil.

The chainspotted geometer, *Cingilia catenaria* (Drury), feeds on a wide variety of trees and ground-cover plants and is occasionally abundant on larch in eastern Canada and the northeastern United States. The larvae feed from June to August. When full grown they are about 45 mm long. Winter is spent in the egg stage.

The pepper-and-salt moth, *Biston betularia cognataria* (Guenée), feeds on various trees and shrubs, including larch, across Canada and the northern United States. The larvae feed mainly from July to early September and are about 45 mm long when full grown. No serious injury to trees by this looper has been reported to date.

Other loopers only occasionally found on larch are illustrated in *Insects of Eastern Spruces, Fir and Hemlock*. These species are the false hemlock looper, *Nepytia canosaria* (Walker); the fringed looper, *Campaea perlata* (Guenée); the diamondbacked conifer looper, *Hypagyrtis piniata* (Packard); the spruce-fir looper, *Semiothisa signaria dispuncta* (Walker); the yellowlined conifer looper, *Cladara limitaria* (Walker); the dashlined looper, *Protoboarmia porcelaria indicataria* (Walker); the gray spruce looper, *Caripeta divisata* Walker; and species of *Eupithecia*.

Control measures for loopers on larch are not usually required. If large numbers occur on shade trees, a biological insecticide specifically for caterpillars should be applied before the larvae are full grown.

Chainspotted geometer larva (Photo credit: Laurentian Forestry Centre)

Pepper-and-salt moth larva

Hairy larvae

Rusty tussock moth larva

Whitemarked tussock moth larva

Tufted spruce caterpillar

Two tussock moths, whose larvae occasionally feed on larch, occur commonly on deciduous and coniferous trees from Alberta to Newfoundland and in the northern United States. Larvae of the rusty tussock moth , *Orgyia antiqua nova* Fitch, feed throughout June, July and August. When full grown and about 28 mm long, they spin yellow-gray cocoons of silk and hair in a variety of niches on the tree or on other objects. The larvae subsequently change to pupae in the cocoons. The adults, winged males and wingless females, emerge mainly in August and September. The female lays her eggs in a single-layered mass on the cocoon from which she emerged. The eggs hatch the following spring.

The life history of the whitemarked tussock moth, *O. leucostigma* (J.E. Smith), is similar to that of the preceding species. There are two subspecies present in eastern Canada. *Orgyia leucostigma plagiata* (Walker) is prevalent in the Maritime provinces and in some localities in Quebec, and *O. leucostigma intermedia* Fitch occurs in eastern and midwestern Canada. The full-grown larva is about 35 mm long.

The tufted spruce caterpillar, *Panthea acronyctoides* (Walker), occurs in small numbers on conifers from Alberta to Newfoundland and in the northeastern United States. The larvae feed from July to early September and when full grown are about 34 mm long.

Caterpillar of the larch lappet moth

The larch lappet moth, *Tolype laricis* (Fitch), is found, usually in small numbers, from British Columbia to Nova Scotia and in the eastern United States. Feeding larvae, found mainly in July and August, are about 35 mm long when full grown .

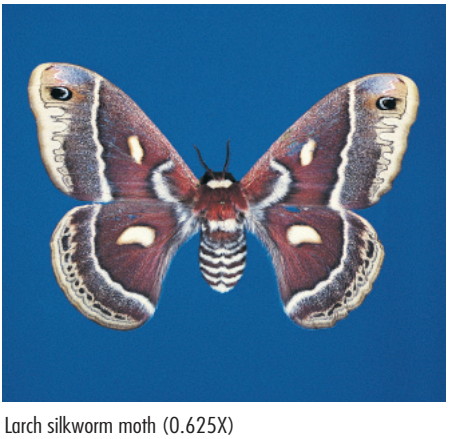
A viral disease and parasites have helped to terminate epidemics of the whitemarked tussock moth in the Maritimes. For valuable ornamental trees and in plantations, a contact, stomach or biological insecticide registered for use against these hairy caterpillars should be applied when the larvae are young to control any of the four species mentioned.

Larch silkworm

Larch silkworm larva (Photo credit: L. Kohalmi)

The larch silkworm, *Hyalophora columbia* (S.I. Smith), is unique in that it is the only member of the family of giant silkworms that feeds on a conifer. It occurs in southern Canada and the northern United States, in a narrow band from southeastern Manitoba and northern Wisconsin to Nova Scotia and Maine. Although this is one of the largest forest insects in Canada, it is relatively rare and there is no record of it causing serious injury to larch.

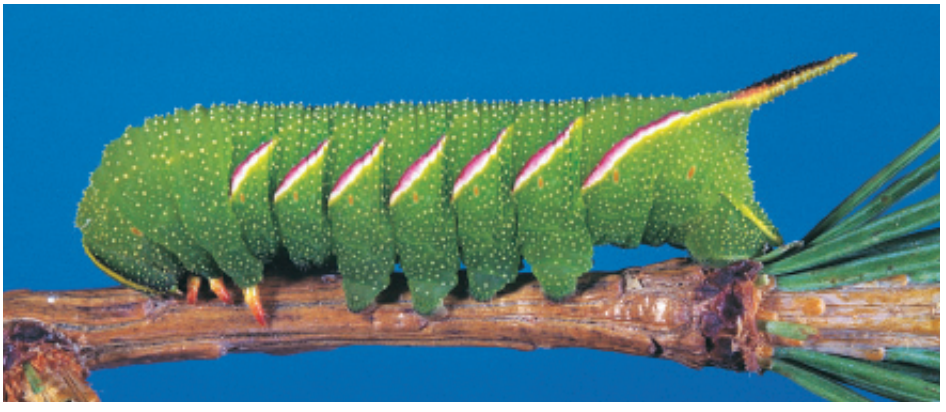
The pea green larvae have prominent warts, feed in July and August and are about 76 mm long when full grown. They spin relatively small, silken, spindle-shaped cocoons that are dark brown with silvery striations, and are usually attached to the host tree. The larvae change to pupae inside the cocoons and overwinter there. The adults fly from May to July.



Larch silkworm moth (0.625X)

Since this beautiful moth is rarely seen, there is an impression that it is becoming extinct. Regardless of the validity of the impression, it should become a protected species and its feeding on larch should be an acceptable price to pay for its presence.

Apple sphinx



Apple sphinx larva

The apple sphinx, *Sphinx gordius* Cramer, is found over a wide area of Canada and the United States east of the Rocky Mountains. It has not caused serious injury to larch but is included here because of its striking appearance and wide distribution. The larvae feed from mid-July to late September and are about 48 mm long when full grown. There is one generation each year and the insect overwinters as a pupa in the soil. The adults are known as hawk moths or hummingbird moths and fly from May to July. Because of their size and their habit of collecting nectar from deep-throated flowers, they may be mistaken for hummingbirds.

Because this larva feeds on a variety of plants ranging from shrubs and fruit trees to conifers, it is not a rare insect, and damage to larch is of little consequence. Rather than being considered an enemy as many of our forest insects are, this striking larva should be viewed as an interesting and colorful part of our environment.

Spruce spider mite

The spruce spider mite, *Oligonychus ununguis* (Jacobi), is often a serious pest on planted spruce and coniferous hedges. It is occasionally found in large numbers on larch, where feeding by the tiny mites causes a mottled discoloration of the needles .

This mite overwinters in the egg stage on the twigs . The eggs hatch in early spring. The mites feed by sucking sap from needles or shoots and spin fine silk as they move about on the foliage. They are oval and vary from dark green to dark brown. When full grown they are about 0.5 mm long. Five to eight generations of mites may develop before the onset of cold weather in the fall. Further information on this species may be found in *Insects of Eastern Spruces, Fir and Hemlock*.

If chemical control measures become necessary, a pesticide effective against mites and safe for the targeted tree should be used.

Discolored needles

Spruce spider mite eggs

Spruce gall adelgids

The spruce gall adelgid, *Adelges lariciatus* (Patch), and the pale spruce gall adelgid, *A. laricis* Vallot, two common spruce gall adelgids, feed in alternate years on spruce and larch. They have complex life cycles and six generations usually occur in the 2-year cycle (see pages 46 and 47). Winged adults, about 2 mm long, occur only in the generation that moves from one kind of host tree to the other. In addition, two other little-known species of *Adelges* have been found in larch cones.

On larch, *A. lariciatus* is sometimes conspicuous because of the white wool which is produced by the feeding adelgids on the damaged needles . Other generations of these adelgids occur on twigs and in cones .

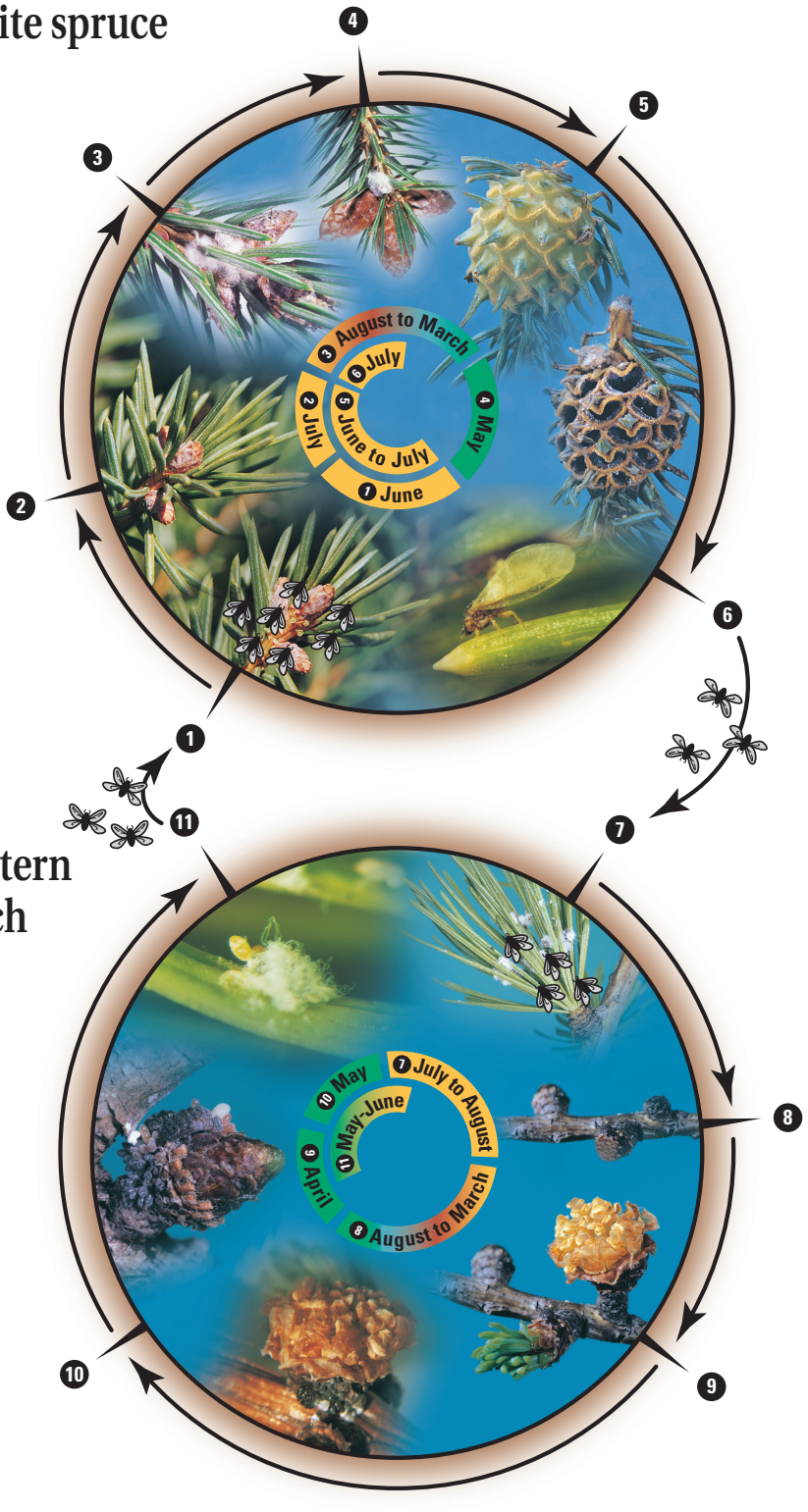
Serious injury to larch by spruce gall adelgids has not been recorded. However, if an abundance of adelgids and white wool appears on ornamental trees, they may be treated with an insecticide when the adelgids first appear on the tree in early May.

Damaged needles

Spruce gall adelgid female and eggs on twig

Spruce gall adelgid female and eggs on cone scale

Simplified adelgid life cycle on alternate hosts



A. White spruce

1. Adults of the sexuparae generation lay eggs on spruce needles in late spring that give rise to a sexual generation (sexuales).
2. Females of the sexuales generation each lay a single egg in midsummer.
3. Female nymphs emerge in late summer and settle near a bud on the primary host, overwintering as second-instar nymphs.
4. These nymphs mature into wingless females (fundatrices) and lay eggs in early spring when the buds are swelling.
5. These eggs give rise to the gallicolae generation. Newly hatched nymphs crawl to base of needles during bud burst and begin to feed, stimulating gall development. They remain inside the gall until mature.
6. Galls open in late summer releasing winged adults which disperse to larch.

B. Eastern larch

7. Winged adults of the gallicolae generation lay eggs on the lower surface of current year needles.
8. These eggs give rise to the sistens generation, which overwinters as first- or second-instar nymphs on larch twigs.
9. Overwintered nymphs feed on the previous year shoots on the buds or at the base of cone buds and mature in April producing wingless adults.
10. Wingless sistens adults lay large clusters of eggs on larch twigs.
11. Nymphs developing from these eggs feed on larch needles and cones giving rise to either a wingless progredian generation that remains on larch or to a winged generation (sexuparae) that returns to spruce. The wingless progredian generation on larch gives rise to further progredian generation(s) during summer.

Text adapted from R.W. Duncan, 1986, *Common Woolly Aphids of Conifers in British Columbia.* Canadian Forest Service, Pacific Forestry Centre, Forest Pest Leaflet No. 19, 8 p.

Legend

Winged adult in flight

Winged adult laying eggs

Summer

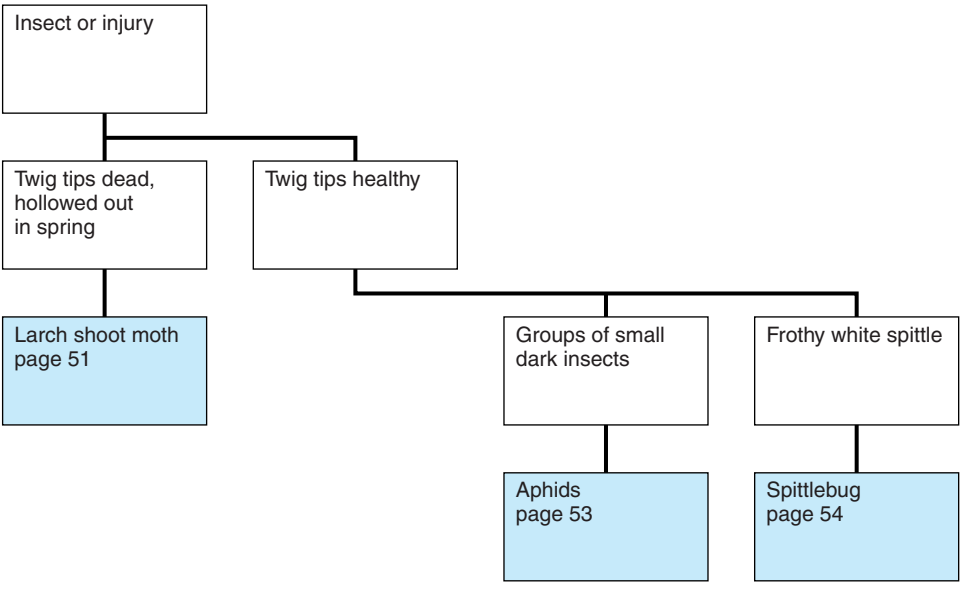
Fall

Winter

Spring

LARCH — SHOOT OR TWIG

Larch—shoot or twig



Larch shoot moth

Damaged tip in spring

Larch shoot moth larva exposed in tunnel

The larch shoot moth, *Argyresthia laricella* Kearfott, probably occurs throughout the range of the native larches in North America, and in southern Ontario it is often abundant in plantations of European larch. The larvae mine the shoots of host trees, but damaged tips do not become evident until the following year. Serious injury, however, is unusual.

The small pale moths fly from late May to August, depending on the climatic zone involved. The eggs are laid singly, usually at the base of a new shoot. The newly hatched larva enters the new shoot near its base and tunnels in the shoot throughout the summer and fall. In late fall, the nearly full-grown larva lines the end of its tunnel with silk and overwinters there . Feeding is resumed during mild periods throughout the winter. The larva completes its feeding in early spring and is about 7 mm long. After cutting an exit hole and covering it with silk, the

Larch shoot moth pupa in tunnel

Adult larch shoot moth

larva changes to a pupa in a silk-lined chamber in the tunnel, from late April to early July. The pupa changes to a moth after about 24 days. The moth emerges from the dead twig tip through the silk-covered exit hole cut by the larva.

Populations of the larch shoot moth are usually controlled by parasites and birds, and large-scale control measures have not been required. On ornamental trees, the infested dead twig tips should be clipped and destroyed in early spring as soon as the new foliage appears.

Aphids

Several species of aphids of the genus *Cinara* live on larch in North America, but serious feeding injury is unknown. The aphids pierce the bark with their long feeding tubes and suck sap from shoots, twigs, branches, stem or roots. They live in colonies and are usually attended by ants, which feed on the droplets of excreted liquid. These aphids vary from gray to brown or black and are less than 5 mm long . All species overwinter in the egg stage. The eggs are black and are laid on the bark of twigs near buds . Six generations in 1 year are not unusual in Canada, and succeeding generations often move to new sites on the tree as the season progresses. The life cycle is complex. For example, adults of the intermediate summer generations consist of females only, some winged and others wingless, both of which produce tiny nymphs rather than eggs. Males occur only in the late fall generation, which produces the overwintering eggs.

Control measures for these aphids have not been required in the forest. When control on ornamentals is necessary, a contact insecticide would be appropriate.

Aphid colony

Aphid

Aphid eggs

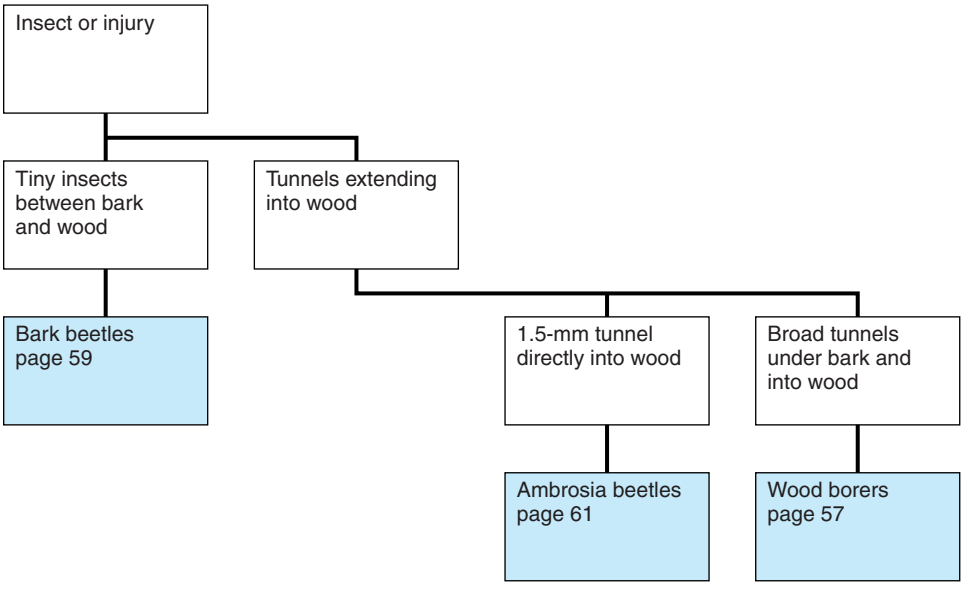
Spittlebug

Spittle mass

The pine spittlebug, *Aphrophora cribrata* (Walker), occurs throughout central and eastern Canada and the eastern United States. It feeds on many conifers but is of concern primarily in pine plantations. Although it is occasionally found on larch, serious feeding injury to that host is unknown. From May to July, one or more immature spittlebugs may be found under each frothy mass of spittle, formed as they feed on the tree's sap. Control, if necessary, requires a contact insecticide applied from mid-May to June with sufficient force to penetrate the spittle mass. Additional information on this insect may be found in *Insects of Eastern Pines*.

LARCH — STEM OR LOG

Larch—stem or log



Wood borers

Flatheaded borer larva

Wood borers breed in recently dead or dying trees and usually become abundant in storm- or flood-damaged timber, in decadent forests or where extensive harvesting operations have been carried out. The larvae tunnel in the wood and cause undesirable "worm holes" in some wood products.

There are two common groups of wood borers in larch. The roundheaded borers often tunnel deeply in the wood, whereas the flatheaded borers make shallow tunnels and are generally considered less damaging. The normal 2-year life cycle of both groups is essentially the same. They usually pass the second winter as mature larvae at the end of a tunnel in the wood and change to the pupal and then to the adult stage in the spring. The adults emerge in early summer and, after feeding for a short while, seek recently dead or dying trees and lay their eggs in the bark or under bark scales. The larvae, on hatching, tunnel through the bark and

Flatheaded borer tunnel

feed at the interface of wood and bark, lightly scoring the wood surface in the first summer. The boring dust and excrement, which may be relatively loose or tightly packed, and the characteristic tunnels constructed by the larvae often indicate the species group involved.

The shallow, tortuous tunnel with tightly packed boring dust and a relatively flat larval entrance hole in the wood is characteristic of a flatheaded borer larva , such as *Chrysobothris* species. But the deeply scored wood,

Roundheaded borer larva

a more compact tunnel and coarse boring dust, with a more oval-shaped larval entrance in the wood , are typical of second-year feeding by a roundheaded borer larva such as the white-spotted sawyer, *Monochamus scutellatus* (Say). Adult sawyer beetles feed on the bark of living trees and often cause the death of twigs and branches. Additional information on wood borers will be found in *Insects of Eastern Spruces, Fir and Hemlock*.

Roundheaded borer tunnel

For information on the control of borers in logs, consult the appropriate Canadian Forest Service centre listed on page 12. Kiln drying will kill tunneling larvae in lumber. Adults emerging from logs or lumber will not attack the material again. Control of borers in stems of damaged or dying larch used as shade trees is seldom warranted, because the trees are probably already doomed.

Bark beetles

Foureyed spruce bark beetle

Bark beetles of the Scolytidae family feed and breed between bark and wood, frequently engraving both with their network of tunnels. Eight or more different kinds of these tiny beetles feed in weakened, dying or dead larch. The two most common species are the eastern larch beetle, *Dendroctonus simplex* LeConte, which feeds exclusively on larch, and the foureyed spruce bark beetle ▭, *Polygraphus rufipennis* (Kirby), which feeds on several conifers. When both are present on standing trees, the larger eastern larch beetle is found more frequently on the lower part of the stem and the other is found on the upper part. Because of similarity in all stages of development, the identification of bark beetles is best left to specialists.

The eastern larch beetle ▭ is treated here as an example. It overwinters mainly in the adult stage. The adults, about 4 mm long, emerge from the bark in May and, on finding suitable breeding material, bore directly through the bark.

Eastern larch beetle

Their attack on living material is marked by a flow of resin and dark brown boring dust. The wide tunnels, called galleries, in which the eggs are laid, are mostly in the bark, and the wood is only slightly scored. The larvae complete development there in about a month and then change to the pupal and adult stages in the succeeding month. The parent adults leave and construct a second set of egg galleries in suitable material and a second brood develops to the adult stage that summer. A third brood is often initiated in other material, but these individuals usually do not develop beyond the larval stage that year. Parent beetles usually die in the third brood gallery.

Removal of dead or dying timber from a forest stand will prevent the development of destructive populations there. Control of bark beetles in individual shade trees is seldom warranted, because the tree is usually seriously weakened by other factors before the beetles appear.

Eastern larch beetle larvae and pupae in tunnels

Ambrosia beetles

Tunnel in balsam fir

Young adult striped ambrosia beetle in tunnel

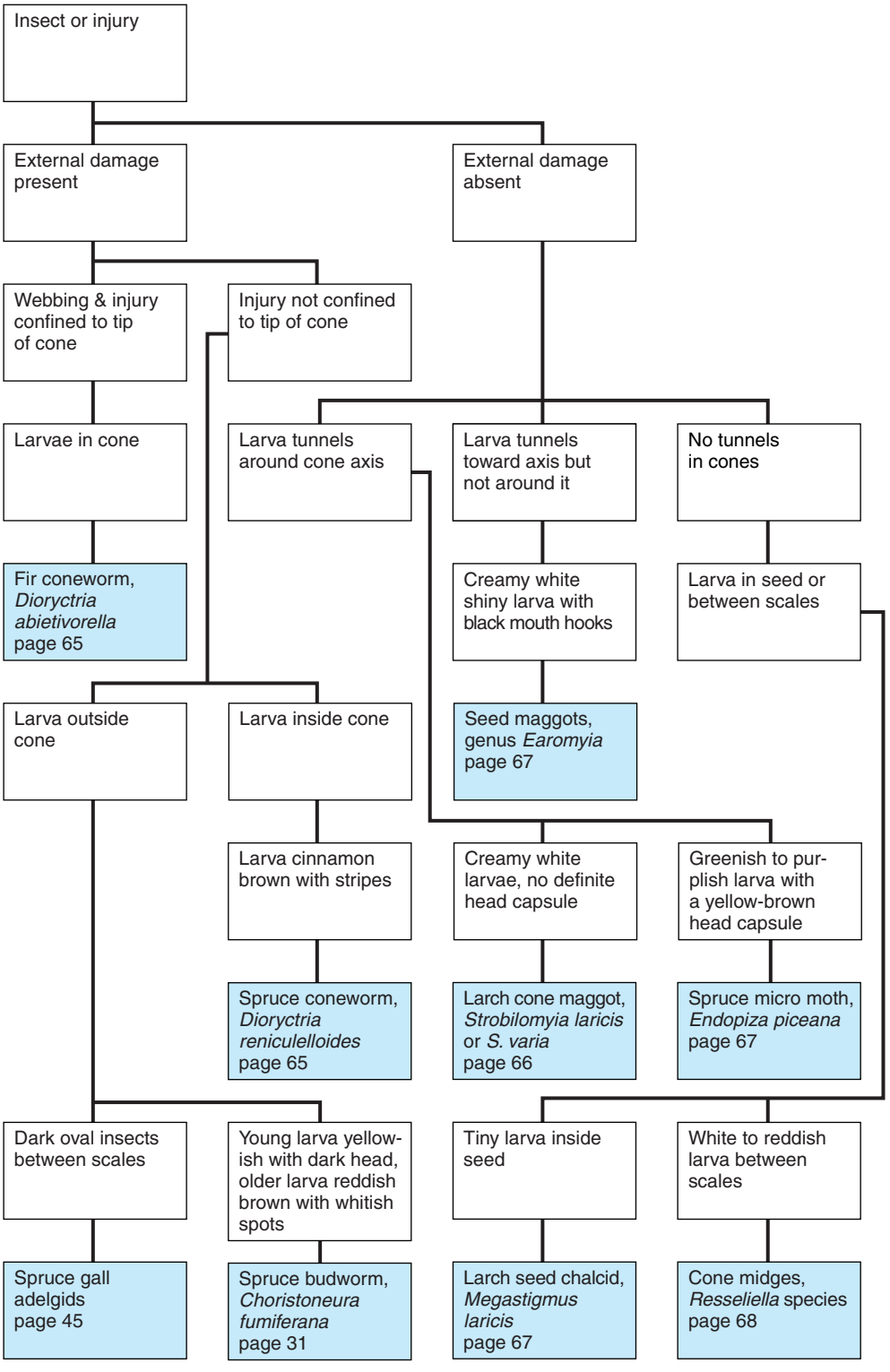
Ambrosia beetle damage is characterized by a circular tunnel that goes directly through the bark and into the wood. Moreover, the walls of tunnels and the adjacent wood are stained black by the fungus on which the beetles feed. Tunnels usually occur in the outer wood of logs, are free of boring dust and may be simple or branched. These beetles will attack and survive only in unseasoned wood; when the moisture content of the wood decreases, development stops. The tunnels of ambrosia beetles cause no lessening of structural soundness of the wood, but the stain may be undesirable.

The life history of the striped ambrosia beetle, *Trypodendron lineatum* (Olivier), is typical for the group. Adult emergence from hibernation sites occurs soon after the snow has gone. Male and female beetles work together constructing the galleries. The eggs are laid in niches, in the tunnel branches which sometimes follow annual rings, and the larvae, on hatching, extend the niche to form a cradle where development is completed. The young adults leave to find hibernation sites. The original pair of adults may have two to three broods in different breeding material in the first year and may produce additional broods in the succeeding year.

For control measures against ambrosia beetles in the forest, consult the appropriate Canadian Forest Service centre listed on page 12. Beetles will not infest stored wood with bark removed, and any beetles emerging from structural material around homes are a nuisance only.

LARCH — CONE

Larch—cone


Insect or injury
External damage present
External damage absent
Webbing & injury confined to tip of cone
Injury not confined to tip of cone
Larvae in cone
Larva tunnels around cone axis
Larva tunnels toward axis but not around it
No tunnels in cones
Fir coneworm, *Dioryctria abietivorella* page 65
Creamy white shiny larva with black mouth hooks
Larva in seed or between scales
Larva outside cone
Larva inside cone
Seed maggots, genus *Earomyia* page 67
Larva cinnamon brown with stripes
Creamy white larvae, no definite head capsule
Greenish to purplish larva with a yellow-brown head capsule
Spruce coneworm, *Dioryctria reniculelloides* page 65
Larch cone maggot, *Strobilomyia laricis* or *S. varia* page 66
Spruce micro moth, *Endopiza piceana* page 67
Dark oval insects between scales
Young larva yellowish with dark head, older larva reddish brown with whitish spots
Tiny larva inside seed
White to reddish larva between scales
Spruce gall adelgids page 45
Spruce budworm, *Choristoneura fumiferana* page 31
Larch seed chalcid, *Megastigmus laricis* page 67
Cone midges, *Resseliella* species page 68

Cone insects

Cone damage by spruce budworm

Fir coneworm larva

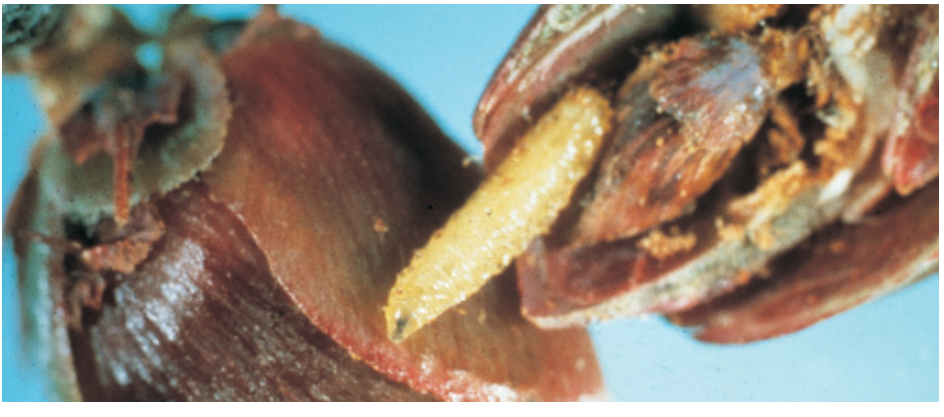
Several different species of insects have been found in eastern Canada feeding on the seeds and cones of larch. They can be divided into two groups based on feeding habits: those that leave external damage and those that do not.

The first group of insects that leave external damage to the cone include the spruce budworm, *Choristoneura fumiferana* (Clemens), the fir coneworm, *Dioryctria abietivorella* (Grote), and the spruce coneworm, *D. reniculelloides* Mutuura & Munroe.

The spruce budworm is well known as a foliage feeder, but when populations are at epidemic levels it can be a serious pest of cones of several conifers . The larva develops outside the cone and feeds predominately on the scales. Mature larvae have a dark head, thoracic shield and legs. The body is reddish brown with two rows of white spots along the back.

Both the fir coneworm and the spruce coneworm develop within the cone and can also seriously affect the cone crop. The mature fir

Spruce coneworm larva



The larch cone maggot and the tamarack cone maggot resemble each other (Photo credit: T. Arcand)

coneworm larva has a reddish-brown to purplish-brown body with a darker brown head and thoracic shield . The anal shield is dark brown and has a pale centre. The mature spruce coneworm larva has a cinnamon brown body with two darker broken longitudinal stripes, a dark head and legs .

For those insects that do not leave any external evidence of feeding damage, the larch cone maggot, *Strobilomyia laricis* Michelsen, and the tamarack cone maggot, *S. varia* (Huckett), are the most devastating having the potential to destroy the entire cone crop. Both species feed predominately on the seeds while tunnelling around the cone axis. The larvae of both species are creamy white, legless and without a definite head capsule . Identification is determined by the shape of the mouthparts.

Spruce micro moth larva (Photo credit: T. Arcand)

Earomyia aterrima larva

The spruce micro moth, *Endopiza piceana* (Freeman), also tunnels around the cone axis, but the damage to a seed crop has historically been negligible and its occurrence is rare. The mature larva has a yellow brown head and a green body . The thoracic shield and legs are dark brown.

Seed maggots from the genus *Earomyia* bore towards the cone axis consuming seeds along the way. Infested seeds are flat, resinous and dark brown. The larvae are shiny, creamy white, legless and have distinct black mouth hooks . They resemble the larch cone maggot and tamarack cone maggot described previously.

The larch seed chalcid, *Megastigmus laricis* Marcovitch, is a very tiny insect and the larva completes its development within a single

seed . The larva is white, curved and legless with dark mandibles.

Cone midges from the genus *Resseliella* feed between the cone scales leaving the attacked seeds brown. Cone midge larvae are orange or white, slightly dorso-ventrally flattened and have two prominent pointed lobes at the hind end.

Spruce gall adelgids that have larch as an alternate host are often found between cone scales on larch (see page 45).

A review of this information on cone insects was provided by J.J. Turgeon (Canadian Forest Service, Great Lakes Forestry Centre). For further information on control of cone insects, consult specialists at the appropriate Canadian Forest Service centre listed on page 12.

Larch seed chalcid adult

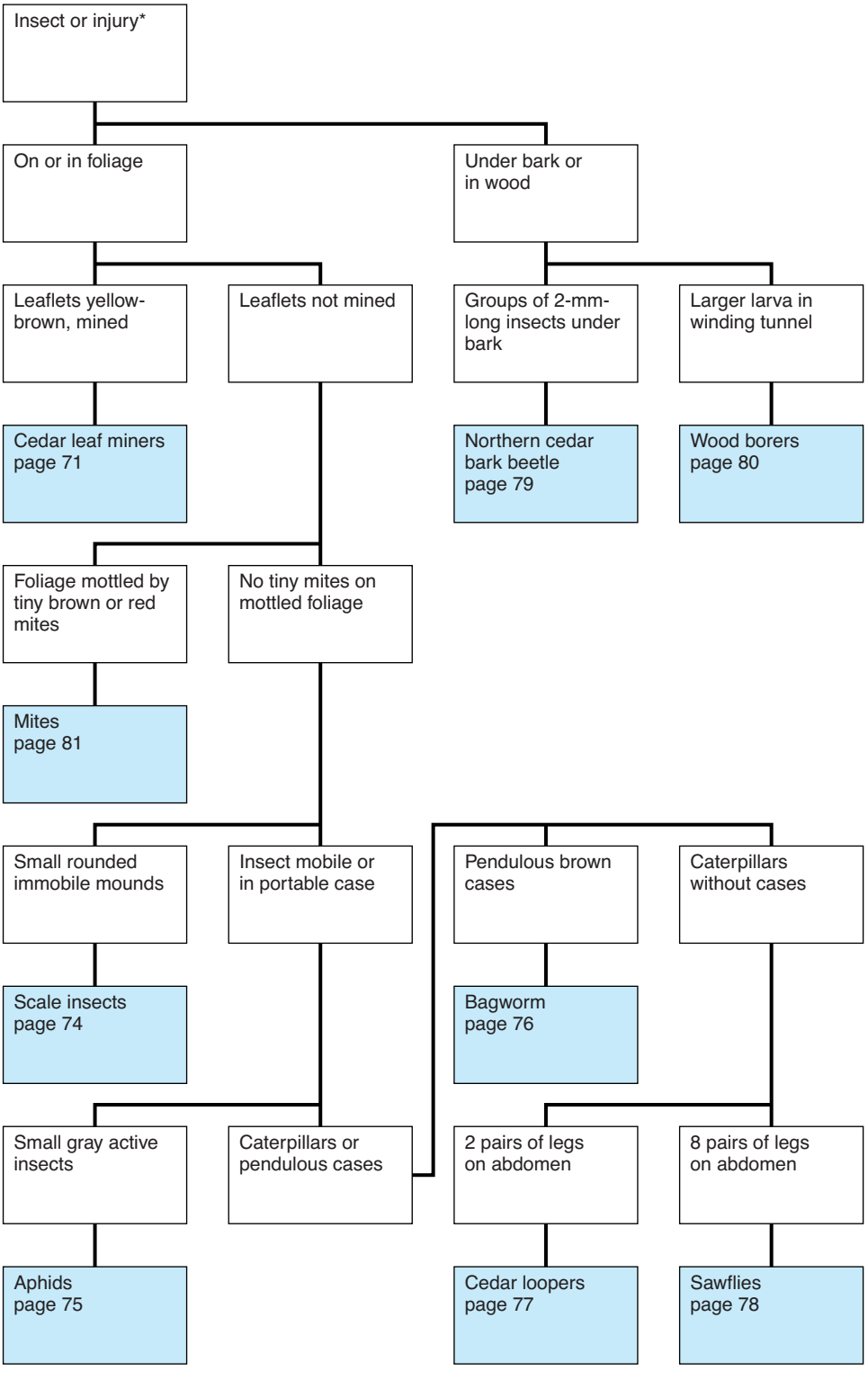
Larch seed chalcid larva

Cone midge larva

Cedar

Cedar

* See also **Discolored foliage**, page 95.



Cedar leaf miners

Damaged trees

Body of larva green; pupa in mined leaflet, green, curved at tip, the arborvitae leafminer..... *Argyresthia thuiella* (Packard)
Body of larva green; pupa on foliage in a white silken cocoon.... ..... *Argyresthia aureoargentella* Brower
Body of larva green; pupa on foliage in a brown-flecked cocoon .. .. *Argyresthia canadensis* Freeman
Body of larva brown; pupa in mined leaflet, brown, not curved at tip, the brown cedar leafminer.... *Coleotechnites thujaella* (Kearfott)

The cedar leaf miners, also called arborvitae leaf miners, are common pests of cedar in eastern Canada and the northeastern United States. Although *Argyresthia thuiella* is perhaps the most common species in Ontario, it is not uncommon to find all four species in a single location. Feeding by these insects has caused severe "scorching" of the foliage and often subsequent twig, branch or tree kill in southern Ontario, Quebec, New Brunswick and Prince Edward Island. Fortunately, however, severely injured trees will often produce new foliage later in the growing season.

New foliage

Mined foliage

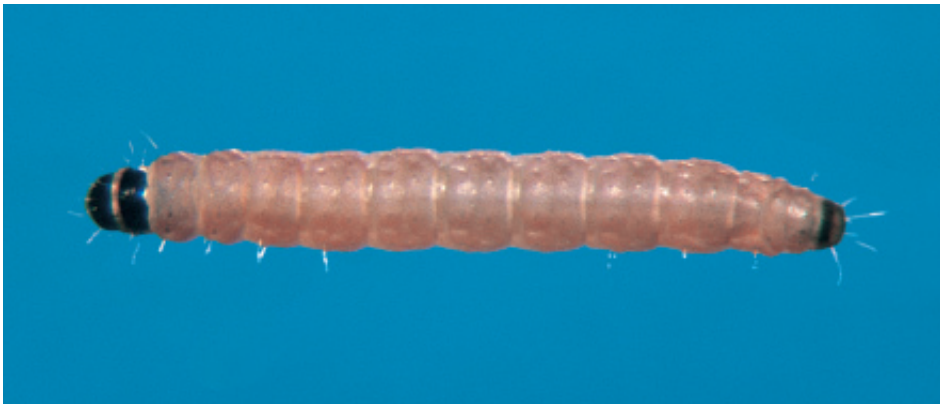
Argyresthia thuiella larva

Argyresthia thuiella pupa exposed

Argyresthia aureoargentella cocoon

Argyresthia canadensis cocoon

Coleotechnites thujaella pupa exposed



Coleotechnites thujaella larva

These leaf miners overwinter on the tree in hollowed out yellow-brown leaflets, the *Argyresthia* species as nearly full-grown larvae and the *Coleotechnites* as younger larvae. Mining is completed in the spring, causing discolored foliage , and the full-grown larvae are 6 or 7 mm long.

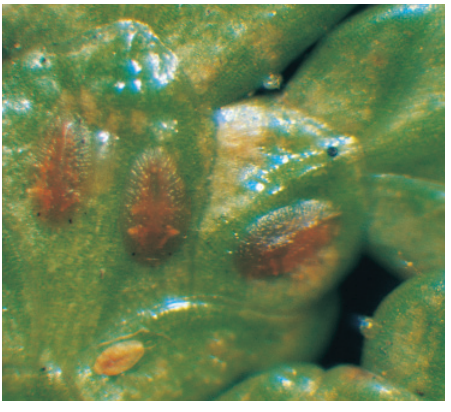
The larva of *A. thuiella* changes to a pupa in the mined leaflet. The curved posterior tip and green color of the pupa are characteristic of the species. The larvae of *A. aureoargentella* and *A. canadensis* resemble the larva of *A. thuiella*. However, they vacate the mined leaflet and change to pupae in silken cocoons attached to the foliage , . In Ontario, adults of the *Argyresthia* species emerge from late May to early July.

The brown larva of *Coleotechnites thujaella* also changes to a pupa in the mined leaflet , but this pupa is brown and the tip is not curved. The adults of this species emerge a few weeks later than the *Argyresthia* species.

Although parasites often kill many cedar leaf miner larvae, other controls may become necessary. In Ontario, a systemic insecticide nontoxic to cedar would be effective if applied in early May or late August. On individual ornamentals, the infested twig tips may be pruned and destroyed before June to provide some control.

Scale insects

Adult Fletcher scale



Crawlers

Scale insects are unusual in that the adult females are immobile and have no appendages showing. The males, which are seldom seen, are winged and only about 1 mm long. Scale insects insert their slender feeding tubes through the bark and feed on sap drawn from a wide variety of trees and shrubs. Heavily infested trees and shrubs lose their color and have thin foliage. Although several species attack cedar and juniper, the following two are most common.

The Fletcher scale, *Parthenolecanium* (=*Lecanium*) *fletcheri* (Cockerell), occurs on cedar and juniper but perhaps more often on yew. In Ontario, it overwinters as a partly grown nymph on the twigs. The nymphs become active again in late April and early May. In June, they settle on the twigs, where they soon assume the shape of the adult scale ☐. Many small whitish eggs are deposited beneath the adult scale. Soon after the eggs hatch, the young, flat, oval "crawlers" ☐ settle on the leaves, where they insert their fine feeding tubes in the leaf and feed until the latter part of September, when they move to the twigs to overwinter.

The juniper scale, *Carulaspis juniperi* (Bouché), is a small circular scale, white with a raised yellow centre. Junipers, especially the ornamental varieties, are occasionally heavily damaged, but cedars are also attacked. In Ontario, the mature scale overwinters. Eggs are present under the scale in June and the "crawlers" are active in July.

If control measures become necessary on ornamentals, a dormant oil may be applied in early spring. Contact or systemic insecticides that are nontoxic to the target tree are recommended for scale insects. They are effective against the crawler stage and should be applied about mid-June.

Aphids

Several species of aphid belonging to the *Cinara* group are found on cedar and juniper. The only one known to occur on eastern white-cedar in Ontario is *C. cupressi* (Buckton). It has not caused serious injury to date. The black eggs , typical of the many members of this group, overwinter on the tree. The gray aphids feed throughout the summer on sap drawn from the leaflets or twigs.

Cinara juniperi (de Geer) is usually a solitary feeder on shoots and twigs of common juniper in Ontario. In the eastern United States, *C. sabinae* (Gillette & Palmer) has been reported in large numbers on eastern redcedar. It is a reddish-brown aphid about 3 mm long, covered with a white powdery substance. When it is abundant, black mold usually develops on excretions of the insect, making the tree unsightly. Further information on the *Cinara* group of aphids is given on page 53.

For control, an insecticide recommended for aphids and nontoxic to cedar or juniper should be used.

Cinara aphid eggs

Colony of cedar aphids

Juniper aphid

Bagworm

The bagworm, *Thyridopteryx ephemeraeformis* (Haworth), is widely distributed in the eastern United States and is occasionally found in Ontario. It feeds on a wide variety of trees but appears to prefer cedar and juniper in Ontario, where it is found mainly in urban areas. The insect derives its name from the bag-like case that is built and carried around by the larva.

The eggs overwinter in the bags on the tree or shrub and hatch in late spring. The young larvae start to feed immediately and to construct bags, using copious amounts of silk with bits of leaf and twig. As the larva feeds, only the head and the thoracic legs protrude from the open end of the finished bag. In the fall, when the larva is full grown, it attaches its bag to a twig with silk and then changes to a pupa. The bags are 25 mm or more long. In about 3 weeks, the pupa changes to an adult moth. The female is maggot-like and wingless with a yellow-white body, naked except for a circle of hairs at the posterior end. The male is sooty black, winged and densely hairy. After mating, the female lays her eggs in the bag, where they overwinter.

Control can be effected by handpicking and destroying the bags while the insects are inside.

Bag on cedar

Cedar loopers

False hemlock looper

Several different kinds of looper may be found on cedar, but their feeding is usually not of serious consequence. One of these, the hemlock looper, *Lambdina fiscellaria* (Guenée), also feeds on larch and is illustrated on page 37. Three other common species are described briefly here.

The false hemlock looper ☐, *Nepytia canosaria* (Walker), feeds on several conifers, including cedar, mainly from June to August. Full-grown larvae are about 25 mm long. Eggs are laid in small clusters on the bark, where they overwinter.

Two kinds of looper that feed almost exclusively on cedar are *Semiothisa orillata* (Walker) ☐ and *Eupithecia gibsonata* Taylor. Their distribution in eastern North America probably coincides with that of eastern white-cedar. The larvae of both species are very similar and are 20 mm or less long. They may be found from early July to late September. Both overwinter as pupae on the ground. Epidemics of these insects are unknown.

Semiothisa orillata larva

If loopers become abundant on ornamentals, they should be handpicked and killed, or sprayed before they are full grown with a biological, contact or stomach insecticide recommended for caterpillars and safe for the targeted tree.

Sawflies

Sawfly larva on cedar

Sawfly larva on juniper

Two or more species of the sawfly genus *Monoctenus* feed on the foliage of cedar and juniper in eastern North America. They seldom cause noticeable injury and, because they are solitary feeders, they are rarely noticed. The larvae feed from June to September and, when full grown, are about 18 mm long □, □. In the fall, they drop to the ground and spin cocoons, in which they overwinter. The larvae change to pupae and subsequently to adult sawflies in the spring.

Control measures have not been required for the cedar and juniper sawflies. If they become numerous on hedges or ornamentals, a contact or stomach insecticide recommended for sawflies and nontoxic to cedar and juniper may be used.

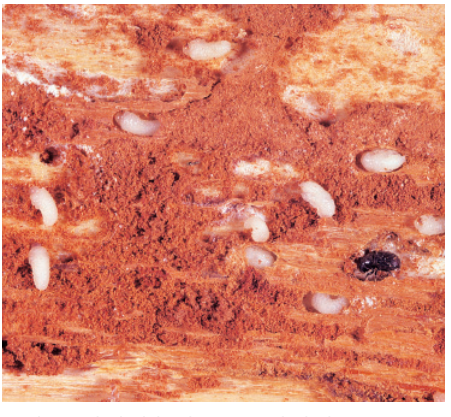
Northern cedar bark beetle

The northern cedar bark beetle, *Phloeosinus canadensis* Swaine, is probably the only bark beetle breeding in cedar and juniper. It attacks damaged, weakened or dying trees and its presence is indicated by fine rust-colored boring dust. Beetles may be found under the bark in all parts of the tree from the small twigs to the heavy-barked trunk. When high populations result from abundant breeding material, adult feeding on twigs and leaves often causes flagging and browning of foliage on nearby healthy trees.

There is apparently one generation each year. The breeding gallery under the bark runs with the grain and is mostly in the wood. The eggs are closely spaced in deep niches along the side. On hatching, the larvae initially construct narrow tunnels that run laterally and then diverge as the tunnels widen to accommodate larger larvae and pupae.

No control measures are known and it is unlikely that any will be warranted. In ornamental plantings, potential breeding material such as dead or dying branches or stems should be removed and destroyed.

Boring dust



Northern cedar bark beetle stages under bark

Adults and eggs in breeding gallery

Wood borers

Adult cedar-tree borer

Tunnels on wood surface

Larva in pupal chamber

Several different kinds of borers feed in dead or dying cedar and juniper trees. The cedar-tree borer, *Semanotus ligneus* (Fabricius), is used as an example here. The adults emerge from their tunnels in May. After selecting suitable material, the females lay their eggs in slits cut in the bark. The larvae soon emerge from the eggs and feed throughout the first summer between the bark and wood, creating tortuous tunnels mostly in the wood. The first winter is spent in these shallow tunnels. The larvae continue feeding throughout the second summer until they are full grown and about 25 mm long. At this time they tunnel through oval holes into the sapwood, where they prepare chambers in which to change to pupae. Later in the fall, the pupae change to adult beetles that remain in the tunnel chambers until the following spring.

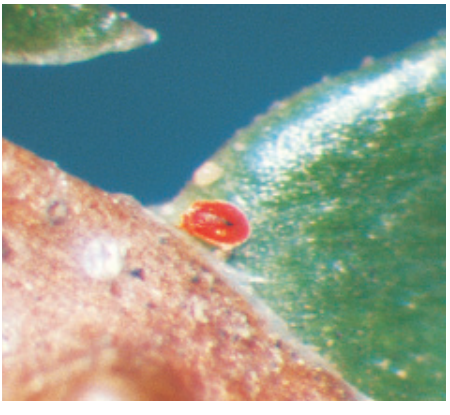
Damage to cedar and juniper has not been sufficiently serious to warrant control measures.

Mites

Cedar damage by spruce spider mite

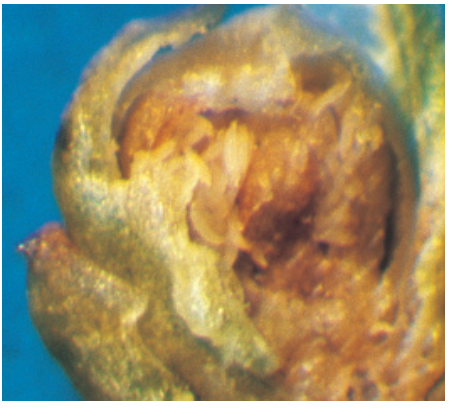
Several mite species are found on cedar and juniper in North America, but by far the most common one in Ontario is the spruce spider mite, *Oligonychus ununguis* (Jacobi). Although difficult to see with the naked eye, it is nevertheless capable of causing considerable damage to ornamental trees and shrubs. These dark-colored mites feed by sucking sap from the leaves and, when abundant, cause mottling of the leaves and eventually early shedding of foliage. As they move about, they spin fine silk over the foliage surface, and the trapped dust and debris heighten the unhealthy appearance. Five to eight generations of these mites can develop during a hot, dry summer, building up incredible numbers. The spider mite overwinters in the egg stage. Additional information on this species may be found in *Insects of Eastern Spruces, Fir and Hemlock*.

Two species of false spider mite also occur on cedar and juniper in Canada, and available



False spider mite on cedar

False spider mite on juniper



Worm-like mites exposed within bud

Juniper tip damaged by bud mite

records indicate that they occur widely in North America. These mites are bright red and have the general shape and size of a spider mite. *Pentamerismus canadensis* MacGregor kills leaflets on cedar ☐ whereas *P. erythreus* (Ewing) ☐, though found on both cedar and juniper, has not caused noticeable damage in Ontario. Little is known about the life history of these two species of false spider mite.

Two other species of mites occasionally found on juniper and cedar are microscopic, worm-like, four-legged creatures ☐ as opposed to the typical eight-legged mites. *Trisetacus thujivagrans* Smith is a bud mite that kills shoot tips of juniper ☐ and it has also been found on cedar. The pile mite, *Eriophyes* species, causes the development of a pile-like

Eriophyes mite damage

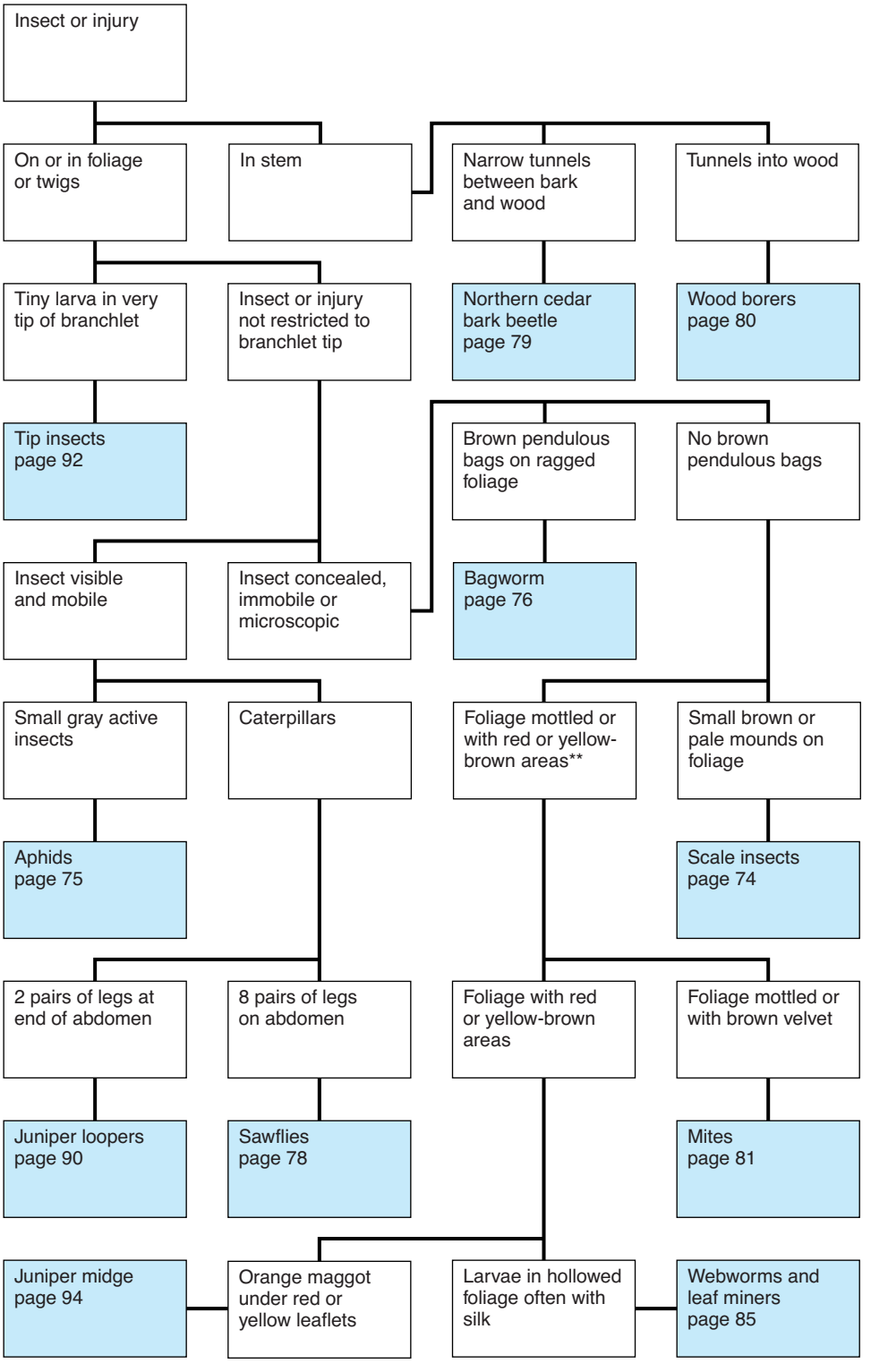
growth on juniper foliage ☐. Both of these species are apparently rare and little is known about their life history.

If control measures become necessary for any mite on ornamental plants, a miticide that is safe for the host tree should be used.

Juniper

Juniper*

* Eastern redcedar, technically a juniper, is included here.
** If insects or their injury are not found, see **Discolored foliage**, page 95.



Webworms and leaf miners

*Material used for illustrations courtesy of Canadian Forest Service, Atlantic Forestry Centre.

Larvae brown, striped or plain; gregarious in nests of dead needles, webbing and excreta ..... Juniper webworms
Larvae green, pinkish or brown; solitary in hollow yellow branchlets, sometimes with silk and excreta ..... Juniper leaf miners, page 86

Juniper webworms*

Two kinds of webworms, both accidentally introduced to this continent, cause browning of foliage on common and ornamental juniper in southern Canada and the northern United States. The moths of the juniper webworm, *Dichomeris marginella* (Fabricius), fly in June and July and lay their eggs in leaf axils of new growth. As the eggs hatch, the tiny larvae mine needles that later turn brown and die. The dead needles are incorporated into a web spun between branchlets and become noticeable on the foliage by early August . The larvae feed until late fall and overwinter in silken cases in the webbed foliage. Feeding is resumed in the spring. The full-grown larva is about 14 mm long with a light brown body and darker longitudinal stripes . In early summer, the larvae change to pupae in whitish silk cases in the webbed foliage.

The pale juniper webworm, *Aethes rutilana* (Hübner), feeds on various junipers but is often quite abundant on the common juniper. In Ontario, the moths fly in late July and early August. The larvae mine needles throughout late summer and fall, and overwinter in silk-lined,

Damage by juniper webworm

Mature larva of juniper webworm

Damage by pale juniper webworm

Mature larva of pale juniper webworm

excreta-covered cases attached to the twigs. Feeding is resumed in the spring when the larva hollows out the needles from the concave surface. The full-grown larva is yellow-brown and about 11 mm long. The larvae change to pupae from late May to early July.

Juniper webworms on ornamental shrubs can be controlled with a contact or stomach insecticide recommended for caterpillars, nontoxic to the affected tree and applied in early spring.

Juniper leaf miners

Because of limited study of juniper insects, little is known about juniper leaf miners. Information on the occurrence of the moth stage is lacking.

On common juniper

In late summer and early fall, the larva of *Coleotechnites gibsonella* (Kearfott) ties the terminal needles into a bundle and mines or hollows them out from the concave side. It overwinters in a silken tube inside the bundle. In the spring, the larva moves to the new growth, where it webs and feeds on the terminal needles. When the larva is full grown, about 7 mm long, it changes to a pupa in the feeding site, about late May or early June.

The young larva of *Argyresthia annettella* Busck also starts mining the needles in midsummer. It tunnels from the base of the needle toward the apex and passes through the shoot from one needle base to the next. After overwintering in the tunnel, it continues feeding in the same manner in the spring. The full-grown larva, probably greenish, leaves the tunnel in May and changes to a pupa in an open-mesh, silk cocoon on the foliage.

A third species, and there may be others, is *Coleotechnites juniperella* (Kearfott), reported from the northeastern United States.

Tip damaged by *Coleotechnites gibsonella*

Argyresthia annettella cocoon

Mature larva of *C. gibsonella*

On eastern redcedar

The larva of *Argyresthia freyella* Walsingham overwinters in the hollowed out scale-like leaves. After feeding in the shoot tips for a short period in the spring, the larva is full grown and about 7 mm long. It changes to a pupa, in a spindle-shaped white cocoon with light brown mottling, on the foliage outside the mine. The moths fly from late May to early July. A little-known species, *A. affinis* Braun, feeds like

Damage by *Argyresthia freyella*

Mature larva of *A. freyella*

Argyresthia freyella cocoon

A. freyella. It probably changes to a green, somewhat curled pupa in the larval tunnel.

The larva of *Coleotechnites albicostatus* (Freeman) mines or tunnels in the scale-like leaves starting near the base of a branchlet and moving towards the tip . It overwinters in a tunnel and resumes feeding in the spring. When the larva is full grown , about the end of May, it changes to a pupa in a cocoon of silk and excreta, spun on the foliage.

The species *Coleotechnites juniperella* (Kearfott) has also been reported mining the leaves of eastern redcedar in the northeastern United States.

Control

A systemic insecticide that is nontoxic to the affected tree would be effective against any young leaf miner larvae on juniper.

Damage by *Coleotechnites albicostatus*

Mature larva of *C. albicostatus*

Juniper loopers

Two groups of loopers in the genera *Thera* and *Eupithecia* feed on juniper, occasionally causing severe browning of the foliage. The feeding injury is particularly unsightly on specimen shrubs and foundation plantings .

In the first group, three species of *Thera* occur in North America. The larvae are similar for all three and, when full grown, are about 17 mm long. The larvae of *Thera otisi* (Dyar) feed from late May to late August in Alberta and southeastern British Columbia. Two species, *T. juniperata* (Linnaeus) and *T. contracta* (Packard), occur in eastern Canada and the northeastern United States. Both overwinter on the foliage in the egg stage. In Ontario, the larvae of *T. juniperata* feed from June to October. The larvae change to pupae in the fall near the feeding sites or on the ground under the shrubs. The adult moths emerge from the pupal cases from September to early October and lay their eggs on the foliage. The life cycle of *T. contracta* is similar to that of the preceding species. However, the moths are apparently in flight much earlier, mainly from late July to September.

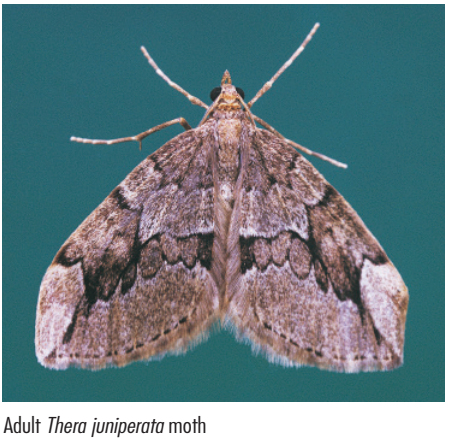
In the second group, *Eupithecia pusillata interruptofasciata* Packard occurs throughout eastern North America. Winter is spent in the egg stage and the larvae feed from May to July. Full-grown larvae are about 13 mm long. The moths fly from late August to mid-October. Another species in this group, *E. intricata taylorata* (=*arceuthata*) Swett, has a transcontinental range. Pupae overwinter and the moths fly in June and July. The larvae, which are similar to those of *E. pusillata interruptofasciata*, feed from mid-July to mid-September and, when full grown, are about 15 mm long.

Damaged shrub

For control of any of these loopers, a biological, contact or stomach insecticide recommended for caterpillars and safe to use on the affected tree should be applied when the larvae are small.

Mature *Thera juniperata* larva

Mature *Eupithecia pusillata interruptofasciata* larva



Adult *Thera juniperata* moth

Tip insects

Yellowish or reddish larva, wide at middle, tapering to both ends; head capsule not apparent ..... Juniper tip midges
White larva, wide at thorax, tapering posteriorly; head capsule present though small ..... Juniper tip gall chalcid

Juniper tip midges

Several midges in the genus *Oligotrophus* feed inside the tips of juniper twigs. Apparently, these insects are not common in Canada, but they have been reported from nurseries in the northern United States. Feeding by the larvae of these midges has resulted in unsightly dead tips on nursery stock . In Ontario, small numbers of larvae have been found in tips of naturally growing eastern redcedar.

The larva overwinters in a small chamber in a branchlet tip. In the spring, when the larva is full grown and about 0.75 mm long, it changes to a pupa inside the larval chamber. In a few weeks, the adult midges, small, delicate mosquito-like insects, emerge from the pupal cases. After mating, the female lays her eggs on the new foliage. As the larvae emerge from the eggs they crawl to the branchlet tips and enter the central cavity of a growing tip. Each larva remains in this cavity throughout its entire feeding period. Four generations of these midges in a year have been reported in Ohio. The number of generations in Ontario is not known.

If control of juniper tip midges becomes necessary, a systemic insecticide nontoxic to the affected tree and applied in late May could be effective.

Juniper tip midge damage

Juniper tip gall chalcid

The juniper tip gall chalcid, *Rhopalicus* species, has been found in considerable numbers on eastern redcedar in Ontario, yet it causes little noticeable injury. The species has also been reported in Ohio. Injury by this chalcid is very similar to that caused by the tip midge in that only the very tip of the branchlets is affected.

The chalcid overwinters as an immature larva in the swollen tip gall. The larva is white, tapering to the last abdominal segment, which bears a long spine-like tail that is slightly curved and can be seen under magnification. When disturbed, the larva reacts by quickly rotating the abdomen in a circular motion. When it is full grown and about 1 mm long, the larva changes to a pupa in the gall. The pupa is entirely dull black. The tiny brilliantly colored adult soon emerges from the pupa and the female lays her eggs on the new foliage. Two or three generations a year are reported in Ohio.

Control has not been required for the tip gall chalcid, but if it becomes necessary, a systemic insecticide safe to use on the affected tree and applied in early spring would be appropriate.

Gall caused by a juniper tip gall chalcid, *Rhopalicus* species

Juniper tip gall chalcid larva in open gall

Adult juniper tip gall chalcid

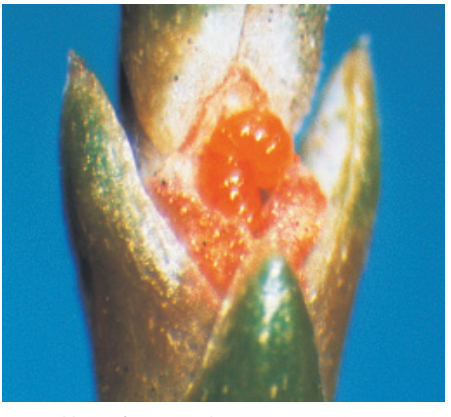
Juniper midge

The juniper midge, *Contarinia juniperina* Felt, probably occurs throughout much of the range of eastern redcedar in North America. The insect has been reported on many kinds of juniper in the United States but in Ontario is known only on eastern redcedar. Tips on injured trees turn brown during June and July because of midge feeding during the previous summer. Serious injury by the midge has not been recorded in Canada.

The larvae apparently overwinter in the feeding site, a reddish or yellow blister at a needle base, or in the ground under the tree. The full-grown larva is about 2 mm long, bright orange and spindle-shaped. In spring, the larvae change to pupae in the ground, and the adult midges emerge from late May to July. After mating, the females lay their eggs on juniper foliage near the branch tips. When the eggs hatch, the larvae bore into the branchlets, where they feed throughout the summer. Some may complete their feeding and drop to the ground in the fall, but it seems that in Ontario the majority overwinter in the foliage.

If control of the juniper midge becomes necessary, a systemic insecticide safe to use on juniper should be applied at 2- to 3-week intervals starting in late June.

Damaged needle



Exposed larva of juniper midge

Adult juniper midge

Discolored Foliage

Discolored foliage

Juniper winterkill

Weevil larva

Natural browning of cedar

Herbicide injury to larch

Sometimes foliage of branches or even of the entire tree turns yellow to brown although no obvious cause of injury can be found. This may be caused by root-feeding insects such as the C-shaped whitish larvae of weevils in the genera *Hylobius*, *Phyllobius* and *Otiorhynchus*. Foliage discoloration may also be caused by changes in soil levels, water levels, soil compaction and soil contamination, or by disease organisms. Cedar and juniper plantings are particularly susceptible to damage known as "winterkill", which is characterized by tips of twigs or entire shrubs turning yellow or brown in early spring. This discoloration results from unfavorable winter weather conditions or lack of hardiness. In the fall, however, when the oldest branchlets on cedar—those nearest the trunk—turn rusty red, there is no cause for alarm. A natural phenomenon is occurring: the trees are shedding their oldest foliage. When needles of larch turn yellow in summer with no evidence of insect feeding, the cause may be environmental disturbances or herbicides; in the latter instance there is distortion of the new growth. Larch needles turn yellow in late fall before shedding; it is the only native conifer that sheds all its needles annually.

Fall color of larch

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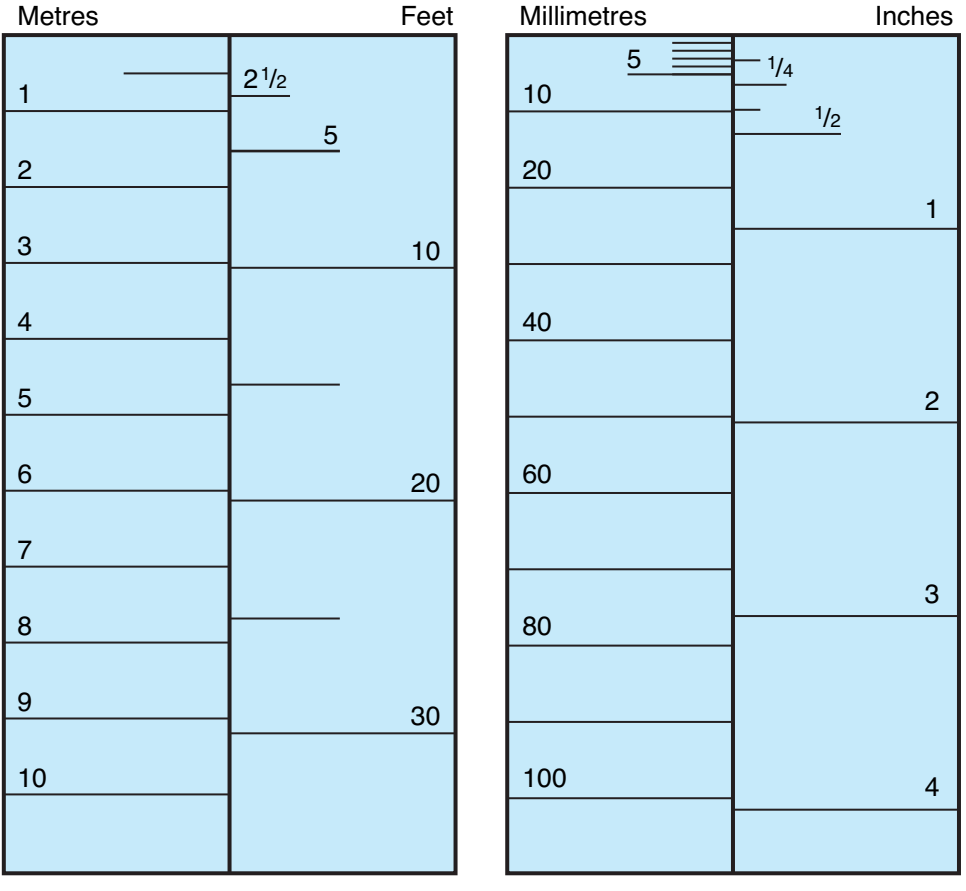

Area
1 cm^2 = 0.155 in^2
1 ha = 2.47 acres

Volume
1 m^3 = 0.276 cord