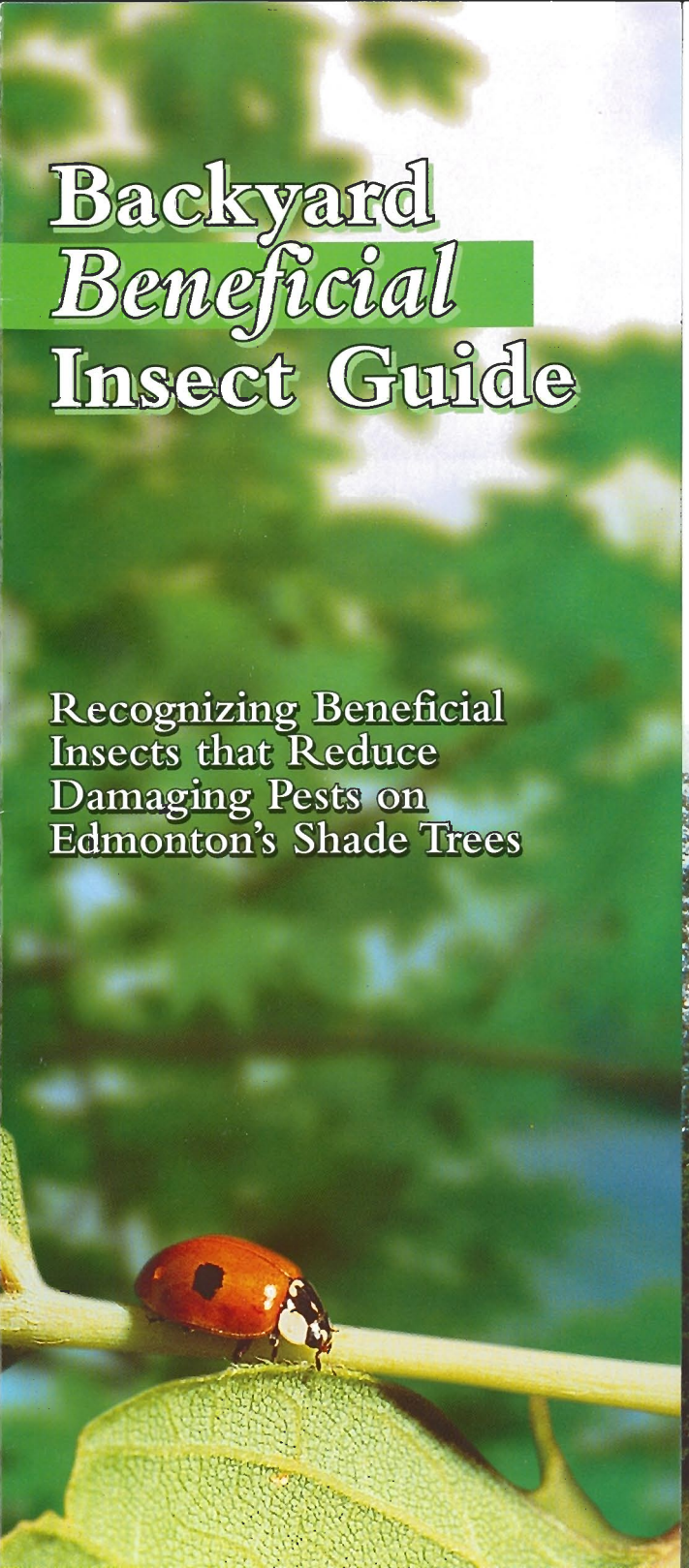
Backyard *Beneficial* Insect Guide

Recognizing Beneficial Insects that Reduce Damaging Pests on Edmonton's Shade Trees



Before you squish, swat or spray be sure you're not destroying useful insects. Use the photos and life-sized silhouettes in this guide to help you recognize some of the beneficial insects that live in your own backyard. Improving our knowledge about these natural enemies can provide the basis for more ecologically-sound solutions to insect pest problems on plants.

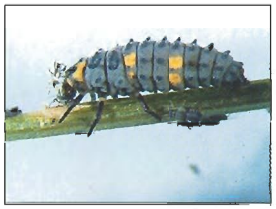
Plant-feeding insects can be a very destructive component of plant communities when the balance of nature is upset. Outbreaks of plant feeders such as the forest tent caterpillar can build quickly because of the large numbers of offspring produced by female moths. So what keeps the caterpillar numbers under control at other times? This is not fully understood, but can involve: 1) plant resistance, which can change a plant's attractiveness as a food, 2) other organisms that attack them, called their natural enemies, and 3) environmental factors such as weather extremes. Together, these factors act to reduce a given population of the plant feeders from one generation to the next. For each species of plant feeder, natural enemy and plant resistance components will differ. Some of these biological factors only play an important role when plant feeder numbers are high enough, explaining how an increasing plant feeder population can be reversed. This in turn can lead to repetetive rising and falling of plant feeder abundance over a number of generations, commonly known as "population cycles".

Plant-feeding insects typically have many different types of natural enemies. These include disease causing fungi, bacteria and viruses, a wide range of predators, and probably the least known group of natural enemies – the parasitoids. Our native plant feeding insects like the forest tent caterpillar and the eastern spruce budworm, have scores of different enemy species attacking them. Many of these enemies take advantage of the most available prey they can tackle. Others are more selective of their prey, feeding on only a few species, or just one.

Predatory insects are quite general feeders, lacking any real preference for a particular species of prey. Some specialize on certain types of prey but if normal food items become scarce, they may resort to feeding on other predators that they can overpower. If hungry enough these predators will even cannibalize young of their own species.

Predatory stink bug attacks an adult ladybird beetle.

Adult ladybird beetles are well known aphid hunters. During development each ladybird beetle larva can consume hundreds of aphids or similar soft-bodied, sapsucking garden pests. Like green lacewings, ladybird beetles are commercially available for biological pest management. These predators however are more manageable in closed systems, like greenhouses, rather than in outdoor applications.

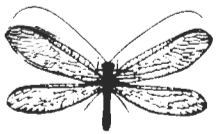


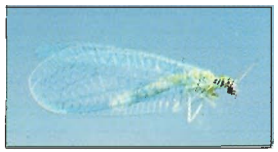
Immature ladybird beetle
Location: Most plants

Two spotted ladybird beetle*, adult – **Location:** Most plants

Aphid-lions use their long, curved mouthparts to catch, puncture and suck dry their prey. Food items include aphids, other small, soft bodied insects and mites. Aphid-lions develop into green lacewings that hunt similar prey and are recognized by their green color, net-like wings and clumsy flight.

Aphid-lion*
Location: Most plants

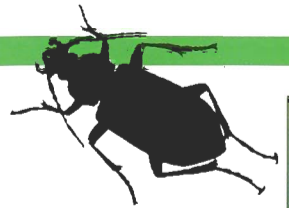




Green lacewing**
Location: Most plants

The immature stages (maggots) of many flower flies prey almost exclusively on aphids. The adult flies, many of which sport brightly colored body stripes, are also known as hover flies. These skilled fliers are most commonly seen hovering in the air next to flowers, appearing motionless as they search for a meal of pollen or nectar.

*Flower fly maggot**
Location: Most plants



Larger insect predators, like some ground beetles prey on quite large caterpillars that are frequently stalked at night-time. During daylight the same caterpillars may fall prey to yellow jacket wasps that carry them off to feed their young. Colonies of these stinging wasps can be troublesome whenever they exist close to human activity.

Ground beetle* - *Calasoma frigidum* attacking forest tent caterpillar
Location: Widespread

Yellow jacket wasp*
Location: Widespread

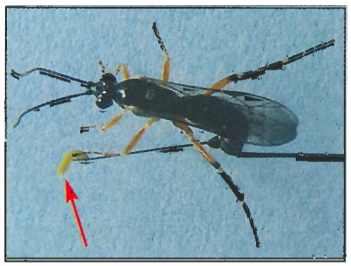
PARASITOIDS are a group of insects with parasite-like larvae. Unlike true parasites, the larvae of parasitoids normally kill their host then become free-living insects *i.e.* they no longer depend on their host. The great majority of parasitoids belong to several families of the non-stinging wasps and a few families of flies. Like the predators, many parasitoids feed on a wide range of organisms (hosts), including other parasitoids. Some parasitoids even attack the parasitoids of parasitoids. External parasitoids, like the wasp, *Pnigalio*, are similar to predators in the way they feed from *outside* their host. External parasitoids appear to be found only in very protected situations where they feed and develop on their living host, somehow keeping it in a suspended state of development.

Pnigalio wasp larva (upper) feeding on an ambermarked birch leafminer.
Location: Inside mined birch leaf.

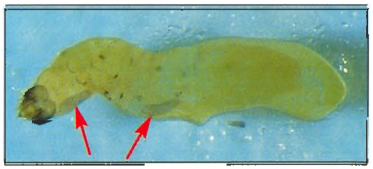
Many parasitoids feed and develop *inside* a particular immature stage of their host, either the egg, larva or the pupa. Known as internal parasitoids, these must be capable of coping with their host's physiological defence system. This restricts many internal parasitoids, especially those entering host larvae, to a narrow range of closely-related plant feeders. Many internal parasitoids are therefore quite host specific *i.e.* dedicated to one or a few host species, compared to externally feeding predators (and parasitoids).

Internal parasitoids enter their host through various means. In many species of parasitoid wasps, the mother wasp inserts an egg inside the host with her needle-like egg laying organ (ovipositor). In other wasp species the mother wasp attaches an egg to the outside of the host's body. This egg hatches and the larval wasp burrows inside. Some parasitoid flies similarly lay eggs on their host, whereas others lay live larvae that burrow into the host's body. Some parasitoid flies simply lay their eggs on the leafy food supplies of their caterpillar host. In this manner, the internal parasitoid gains entry by the host feeding on infected leaves.

Glypta fumiferanae is a wasp that attacks only young eastern spruce budworm caterpillars in late summer. The female unsheathes her long ovipositor, projecting it forward, between her legs, to inject an egg into a young budworm caterpillar. Inside the small budworm, the wasp egg hatches into a grub-like larva which becomes inactive over winter. Spring's arrival signals *Glypta* larvae to resume feeding on host tissues. Somehow the budworm continues developing until about June when the wasp larva chews its way out of the mature caterpillar or pupa, killing it. The free-living larva then quickly spins a transparent silk cocoon inside which it changes to a pupa.



Glypta attack on hatchling spruce budworm caterpillar
Location: Spruce trees



Squash of spruce budworm caterpillar reveals two *Glypta eggs*

Glypta larva emerging from budworm pupa
Location: Spruce trees

Once outside its host, *Glypta* is vulnerable to attack by other less host-specific parasitoid wasps like *Psychophagus*. These wasps reduce *Glypta's* effectiveness as a natural enemy of the eastern spruce budworm. Further discussion on *Psychophagus* and other generalist feeding parasitoids can be found following the examples of parasitoid flies overleaf.

A metallic green *Pyschophagus* emerges from the remains of a *Glypta* pupa
Location: Spruce trees

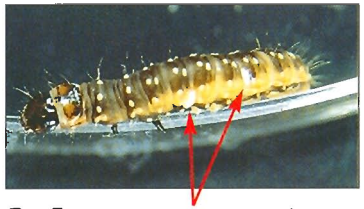
Some female wasps like those of *Excavarus velox*, don't require a long ovipositor. Instead, this wasp anchors a stalked egg onto the head of its host, a larval yellowheaded spruce sawfly. When it hatches, the wasp larva bores into the sawfly and spends the long, cold winter months protected inside the host's soil cocoon. *Excavarus* is just one of many parasitoids to emerge from the sawfly cocoons as adult wasps ready to attack the next generation of sawflies. In an Edmonton study in 1993, sampled soil cocoons of the yellow-headed spruce sawfly were reared to determine parasitoid impacts on the pest. Emergence of at least five parasitoid wasp species occurred for almost two months after completion of the sawfly emergence. Collectively, the parasitoid wasps reduced the yellowheaded spruce sawfly emergence by 68%.

Excavarus velox, ready to attack.
Location: Spruce trees

Yellowheaded spruce sawfly larva with the stalked egg of an *Excavarus* wasp attached to its head.
Location: Spruce trees

Fly parasitoids like *Eumea caesar*, another enemy of the eastern spruce budworm, resemble very hairy house flies. *Eumea* lays distinctive white eggs on large eastern spruce budworm caterpillars. This fly uses a second (alternate) host species of caterpillar in order to complete its annual cycle. In a matter of just weeks after being laid as an egg, a fully developed maggot chews its way out of the dying host. The maggot soon changes to a pupa that lodges amongst the spruce foliage. As in the case of the *Glypta* pupa discussed earlier, the *Eumea* pupa is subject to attack by *Psychophagus* and other generalist feeding parasitoids. Again, enemies like *Psychophagus* counteract the effectiveness of this budworm enemy. *Psychophagus* wasps also attack the spruce budworm itself, but clearly it is the lack of host specificity in this and many other natural enemies that limits their usefulness in controlling populations of plant feeding insects.

Eumea caesar, a parasitic fly
Location: Spruce trees



Two *Eumea caesar* eggs on a mature spruce budworm caterpillar
Location: Spruce trees

Emerging maggot of *Eumea caesar*
Location: Spruce trees

Pupa of *Eumea caesar* killed by a *Psychophagus* wasp
Location: Spruce trees

As mentioned earlier, some parasitoids attack the pupae of plant feeding insects. This is the case for the fly, *Arachnidomyia aldrichi*. Females of this flesh fly lay live maggots on the cocoons of their host, the forest tent caterpillar. These maggots bore quickly through the silken cocoon and into the pupa inside, killing it. During outbreaks of the forest tent caterpillar, this fly kills as many as 70% of the pest's pupae.

Flesh fly attacking forest tent caterpillar cocoon
Location: Trembling aspen, other hardwoods

Telenomus alsophilae wasps emerging from eggs of the fall cankerworm
Location: Manitoba maple, elms, other hardwoods.

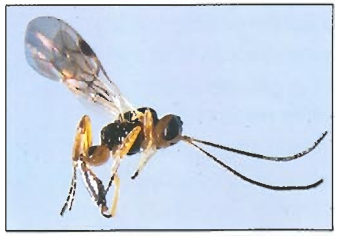
Many wasp parasitoids specialize in developing inside the eggs of plant feeding insects. These are typically very small wasps because of the small size of most insect eggs. In the forest tent caterpillar, a protective material called spumulin covers the eggs and greatly reduces the combined attack by three or four different egg parasitoids. By contrast, the eggs of the fall cankerworm are naked, and just one species of wasp kills most of them in Edmonton. Local studies of a number of egg parasitoids of plant feeders show all developmental stages of the wasps are protected inside the host's egg. This seems to provide no opportunity for generalist feeding wasps to attack them.

Based on the rearing of internal parasitoids from a variety of plant feeding insects in Edmonton, it appears the success of many host-selective flies and wasps depends largely on the survival rate of stages living outside the host. Similar results were found with the wasp *Cotesia melanoscela* which was introduced from Europe to help control gypsy moth in North America.

This wasp species specializes on gypsy moth caterpillars but spends winter as a free-living pupa inside a cocoon that is attached to the tree. In an Ontario study, these cocoons were observed to suffer more than 90% mortality by generalist-feeding parasitoids. In addition, *Cotesia* can effectively attack only small caterpillars, the larger ones being able to fend off attempts by the wasp to attack them. Collectively, these factors severely limit this wasp's success as a biocontrol agent for the gypsy moth.

Besides the gypsy moth, many other plant feeding insects accidentally introduced from Europe or Asia have become pests in North America. This results largely from them becoming separated from their natural enemies. A case in point is the amber-marked birch leafminer, a European introduction, first reported in Edmonton in the early 1970's. This species grew to become the most important exotic leafminer on Edmonton's birch trees. Attacks by the wasp *Pnigalio*, and other non-selective, local external parasitoids had little impact on the outbreak. In the early 1990's a highly specific enemy of this birch leafminer, the wasp *Lathrolestes luteolator* appeared in Edmonton. Not only did this wasp cause the twenty year long outbreak to crash, it has made this exotic leafminer rare, curing the need for one of the most entrenched and widely practiced insecticide treatments in Edmonton. The rapid success of this wasp can be attributed to its successful overwintering and protection from enemy attack inside its host's soil cocoon.

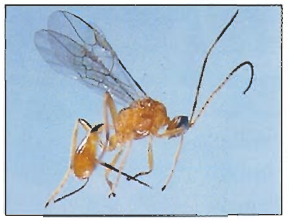
Leaf damage caused by an outbreak of the ambermarked birch leafminer in Edmonton.



Lathrolestes luteolator solved Edmonton's twenty year outbreak of ambermarked birch leafminer

In a similar fashion, Edmonton outbreaks of the satin moth, an introduced pest of poplar and willow trees, have become increasingly troublesome ever since it was first reported in 1994. This has caused widespread insecticide use. Help may be close at hand in coastal British Columbia, where the wasp *Meteorus versicolor* assists in keeping satin moth in check. Since this wasp was found to be absent from enemy surveys of the pest in Edmonton, it has become the target for an inter-provincial capture and release program for the City of Edmonton. *Meteorus versicolor* was selected for the transfer program because 1) it spends the winter protected inside small over-wintering satin moth caterpillars, 2) it has a second generation that can successfully attack large satin moth caterpillars, and 3) its vulnerable cocoon stage is suspended from foliage by a silk thread, thought to reduce attack by predators and non-selective parasitoids.

Ornamental poplar tree, stripped of leaves by satin moth in Edmonton.



Meteorus versicolor, a wasp enemy of satin moth.
Location: Poplar, willow trees in British Columbia

For further information on this subject contact:

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THE CITY OF Edmonton COMMUNITY SERVICES

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