

Leafminers: The Art of Eating a Leaf

Have you ever come across a magnificent insect and wondered where that elegant creature has been all your life? It's happened to me too, time and again. There is one group of insects that actually writes its own life history, the artistic sculptors known as leafminers. This guild (a group of species, related or not, that share a common life style) usually completes their entire larval life inside a single leaf. Their larval life history is clearly displayed in their mines just as though it had been written. From egg, through larval development, and possibly assassination by a parasitoid, it's all there in a single leaf, ready to be read by the careful observer.

Just how can you tell a mine from other leaf marks? A mine is the feeding pattern of a larva as it eats inside a leaf. Eating a leaf from the inside allows the larva to remain protected by the transparent skins (epidermis) of both leaf surfaces. The mine is lighter than the surrounding leaf and will usually have a trail of dark particles (frass) inside. The frass, of course, is the waste matter of its feeding. Use a magnifying glass to look closely. One with a wide lens, up to 1 ½ inches and 5-10x, will give a wide view and let in plenty of light. Hold your leaf skyward to more clearly see through the mine. If you do have a mine you may even be lucky enough to see the artist still working its masterpiece. Mines can be found on trees, shrubs, and herbs. They come in a variety of shapes but each species makes only one shape. A mine can be on either side of a leaf or completely through (full depth). It may even be partly on one side and then the other. Some common shapes you may find are: blotch (oval), serpentine (long thin trail), wide track; or lobed blotch.

Let's use the upper surface mine of *Cameraria aceriella*, a caterpillar on Sugar Maple, to read its story. It looks just like a wide curved track but to determine how it was really made you'll need to follow the frass trail from its beginning. To do that you need to know its mother laid her egg on the leaf surface and the

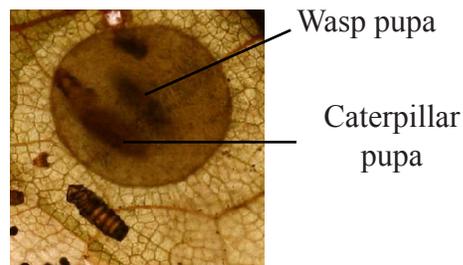


hatching larva chewed directly into the leaf to begin feeding. The trail then begins where you find the smallest frass particles. You can see that

point is now the center of the finished mine. By following this trail, you see what at first looked like a single trail is actually a double trail! The larva turned around and continued feeding parallel to its earlier trail and actually widened it.

Now, do you notice that circle at the end of its trail? Right, it's the caterpillar's cocoon! Notice the objects inside. The long wide one is the caterpillar pupa with its dark crumpled larval skin. It would normally produce a moth but this one has been parasitized by a minute wasp, the widest object. The wasp larva exited the miner pupa, shed its own larval skin, and then pupated next to the caterpillar pupa. This wasp pupa will likely metamorphose into a metallic green or blue-colored wasp about 1 mm long! Parasitoids (parasites that normally kill their host) are one of the common perils of leafminers. Had this miner succeeded in becoming an adult, it would look like the moth pictured here. From wing tip to wing tip it is about 9 mm (3/8 inch) wide. *Cameraria aceriella* has 2 generations each year and is most commonly found in the fall on a variety of maple species.

Though Lepidoptera (caterpillars) are the most common miners, 3 other Orders have leafmining species: Coleoptera (beetles), Diptera (flies), and Hymenoptera (wasps). In all of these Orders, the leafmining is constructed by the larvae. The easiest order to identify is Diptera. The fly maggots lack a distinct head but have instead a pair of sickle-shaped mouth hooks to cut leaf tissue. Beetle larvae are usually widest behind the head with the body narrowing toward the posterior. Wasp larvae look very similar to beetle larvae but their bodies are usually the same width for the entire length. Caterpillars, on the other hand, can look much like fly maggots but with a distinct head and chewing mouthparts. More commonly, leafmining caterpillars



are flattened with each body segment noticeably rounded at its sides.



Let's look at an example from each Order. Fly leafminers are usually quite small but species in the family Anthomyiidae form large communal blotch mines. One species, *Pegomya stagnalis* (above), lays its eggs in groups on the lower leaf surface of its host plant, Dock (*Rumex obtusifolius*). Larvae bore directly into the leaf. Since these individual upper surface mines are close together they soon join forming a communal blotch as large as 17 x 8 cm (8" x 4"). If that mine does not provide enough food, they can move to another spot to complete feeding. The photo of a single mine shows a relocated larva. The plant tissue at the arc-like entrance slit has dried leaving a hole at the mine base. Also notice the dark line at the head (lighter) end of the larva. This is actually a pair of sickle-shaped mouth hooks used to cut through cells allowing the larva to feed on leaf juice. With little solid food, very little frass is produced. Its frass consists of scattered small dark particles clearly visible in this mine. When larvae are fully fed they cut a slit in the leaf, drop to the ground, and pupate in the soil. *Pegomya stagnalis* likely has 2-3 generations each year in Michigan.

Few beetles mine leaves. The genus *Brachys*, in the family Buprestidae, is one that does. They mine leaves of maple, basswood, and beech but primarily oak. The wide track upper surface mine and larva illustrated is *Brachys aerosa* in Red Oak, *Quercus rubra* (above). Its round flat egg was laid on the upper surface and remains attached. It can be clearly seen by turning the leaf until sunlight reflects off its shiny surface. The char-



acteristic wedge-shape of the larva is also apparent. The most striking character in this photo, however, is the two-tone mine. The base portion is a dark tan and the remainder a light green. Completed mines usually have three color tones: tan, dirty green, and lastly clear. These color changes may indicate either resting periods or changes in mine width as the larvae molt and grow. Another character of this mine is the strings of black frass. This may not be evident in the photo since we're looking into the mine through the upper epidermis of the leaf. The three *Brachys* species in northeastern US have only one generation per year, feeding from late June into October. Adults can be seen on sunny days in mid-June feeding on their larval host leaves.

The only Hymenoptera adapted to leafmining are a few species in the sawfly family Tenthredinidae. The example here is *Profenusa thomsoni*, one of four species feeding on Paper Birch, *Betula papyrifera* (to the right). Eggs are usually deposited on the leaf near the main vein. In this photo, the mine origin is seen as the very narrow portion near the main vein. It develops into a wide upper surface blotch with scattered black frass particles. The larva, though similar to a beetle larva, has nearly the same body width from front to rear. Larvae can be found feeding from mid-August through September in Michigan. Full grown larvae remain in their mines, drop to the ground in the leaf, and overwinter. It has only one generation per year.

Some leafminers do not mine their whole larval life. Some exit their mine to pupate when fully grown; some miners exit one mine and begin another; while others mine only when very young then continue feeding outside their mine. There are some leafminers (Heliozelidae) that cut an elliptical-shaped area from both the upper and lower epidermal surfaces of the mine after they have webbed both surfaces together, and after departing to pupate the mined elliptical case looks like a turtle. There are hundreds of leafmining species. Some of their stories still await discovery likely right in your area. Search and discover!



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