

Leaf miners—tiny sculptors in the Kenai forests

by John Lundquist

People describe the damage that insects do to their trees in many different ways—devastating, horrible, beautiful, intriguing, interesting, striking. Many of the same words can be used to describe a painting, print or a sculpture. As autumn approaches, such comments might be increasingly appropriate in the forests along Funny River Road where leaf mining insects are busy sculpting leaves.

Leaf miners are insects that live for at least part of their lives between the outer surfaces of a leaf.

The leaves that they mine show an amazing variety of patterns caused by different feeding habits of these insects. These feeding patterns tend to be distinct enough in a particular tree species or geographical area to identify the insect species involved. Some of the most striking of these patterns are evident now on aspen leaves around Soldotna. The aspen leaf miner (*Phyllocnistis populiella*) causes the winding meandering path across otherwise green healthy leaves; these patterns are called serpentine mines.

The aspen leaf blotch miner (presumably, *Phyllonorycter tremuloidiella*) causes a round to oblong blister, called a leaf blotch. These different insects are common and often found among trees growing at the same site, and, may even occur on the same leaf.

Phyllocnistis and Phyllonorycter are not the only leaf miners common to the Kenai, and aspens are not the only trees affected. The leaf mining habit can be found in some of the most evolutionarily advanced insect orders—moths and butterflies (Lepidoptera), flies (Diptera), wasps, bees and sawflies (Hymenoptera), and beetles (Coleoptera). All these insect orders are common and essential components of the diversity of our forests. Leaves of all tree species on the Kenai are mined.

The Phyllocnistis and Phyllonorycter leaf miners found on Soldotna aspens are moths in the Lepidopteran family called *Gracillariidae*. A unique feature of this family is that adults are commonly very small (usually less than ¼ inch from wing tip to wing tip). It is notable that such small members of the forest community feed on its largest members—trees. In fact, Gracillids represent the largest number of species of woody plant feeders.

Under the right conditions, leaf miner populations can build to immense numbers. When enough leaf miners are present, they can make the crown of a tree look brown or grey overall. At times, especially when other environmental conditions are stressful, an infested tree can turn brown by mid to late summer, and prematurely lose its leaves. Normally, however, infested trees do not die and probably suffer little unless affected several years in a row. Usually, there is no need to apply any kind of control. Population numbers are kept in check naturally by increasingly limited feeding space of leaves infested with multiple larvae and by natural predators, parasites, parasitoids, and pathogens.

The biology of most leaf miners in Alaska has yet to be studied in detail, and indeed much about the insects that are found on the Kenai Peninsula remains unknown. This is not surprising, since Alaska is such a vast place with so many different types of insects.

The life cycle of the aspen leaf blotch miner is probably typical of many other leaf miners. Eggs are deposited by adults soon after emerging from hibernation in early spring. Early-stage larvae drill into the leaf and feed on the inner leaf cells. Larvae are flat, legless with unique mouthparts that are specialized to feed within the confined inner-leaf space. Leaf miners first appear in May or June. Late-instar larvae change their feeding habits and eat cell tissues. Larvae pupate within infested leaves. Moths emerge in August and crawl to safe locations under bark scales of, usually, spruce trees to spend the winter.

Life between the leaf surfaces affords some significant advantages to those insects that live there. Just as leaf surfaces protect the delicate palisade and parenchyma cells that are largely responsible for photosynthesis and other vital functions of a plant, the surfaces protect delicate larval stages of insects from predators. They also moderate fluctuations in moisture and temperature, mediate against environmental conditions damaging to the larvae (including pesticides), and offer easy unlimited access to the palisade and parenchyma cells that the larvae eat.

Leaf miners occur on most trees, other woody plants, on many herbaceous plants, and even on

aquatic plants. Although both the hardwood and conifer forests here are full of many different kinds of leaf miners, most leaf miners are found in tropical areas.

The most noticeable sign of leaf miners is leaf discoloration. The rate at which discolored leaves develop determine the intensity of the infestation. Over the last couple years, summer conditions had been

relatively warm and conducive to rapid development. But this year, things have not happened so fast, and the damage caused by leaf miners has generally been less noticeable.

John Lundquist is entomologist with the US Forest Service, Forest Health Protection office in Anchorage. Previous Refuge Notebook columns can be viewed on the Web at <http://www.fws.gov/refuge/kenai/>.