



CENTRAL HARDWOOD NOTES

Forest Insect Defoliators

Defoliation is the removal of all or part of the foliage from the tree. Forest insects are the primary agents that can cause defoliation. They produce the widespread, noticeable defoliation that forest landowners, foresters, and the general public can easily recognize.

Classification

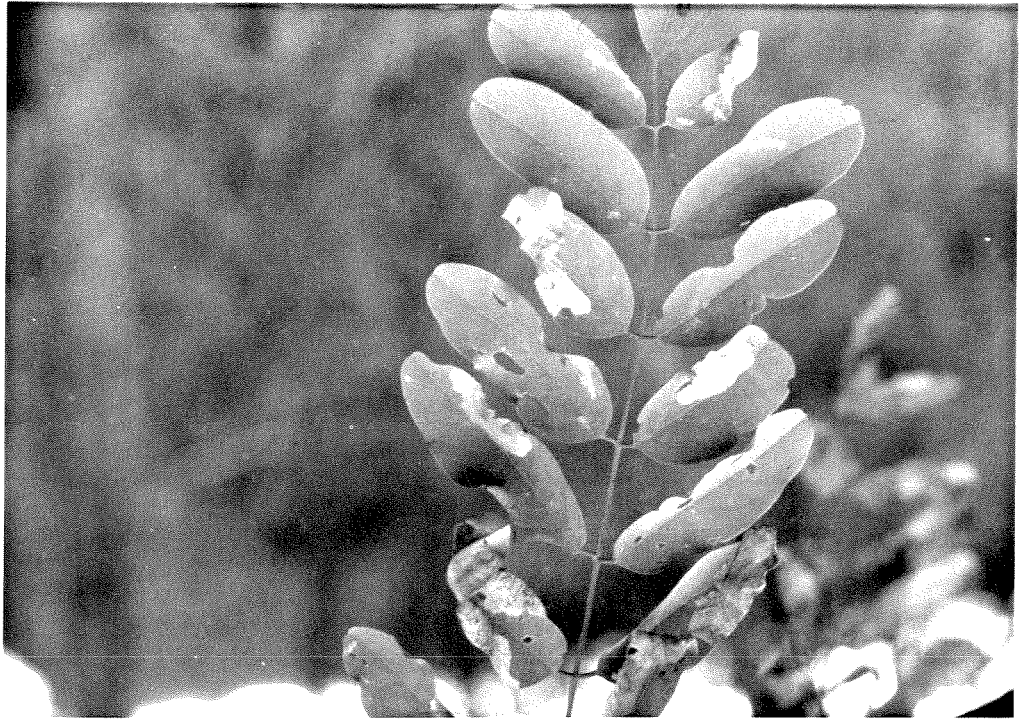
Forest insect defoliators can be classified or described in several ways: defoliation pattern on individual leaves, structures that they create from which to feed, the scientific insect order, and time of the growing season that feeding occurs.

Defoliation Pattern

Defoliators create many patterns of defoliation on the individual leaf. Some insects completely eat the leaf blade leaving only the large veins. Some create a "shot hole" pattern by eating holes in the leaf blade. Other insects make "leaf mines" by eating the middle layer of the leaf. And, one group makes a "skeleton" of the leaf by eating everything but the large and small veins.



"Shot hole" defoliation in sugar maple leaves. (Philip Marshall).



"Leaf mine" defoliation in black locust leaves (Philip Marshall).



"Skeleton" defoliation caused by the maple trumpet skeletonizer, *Epinotia acerella* (Clem.). (James Hanson)

Feeding Structures

Forest insect defoliators are also classified by the structures that they create and use while feeding. These structures range in size from large “tents” holding hundreds of insects, to individual structures containing a single insect. Examples of these are webworms, leafrollers, leaftiers, bagworms, and casebearers.

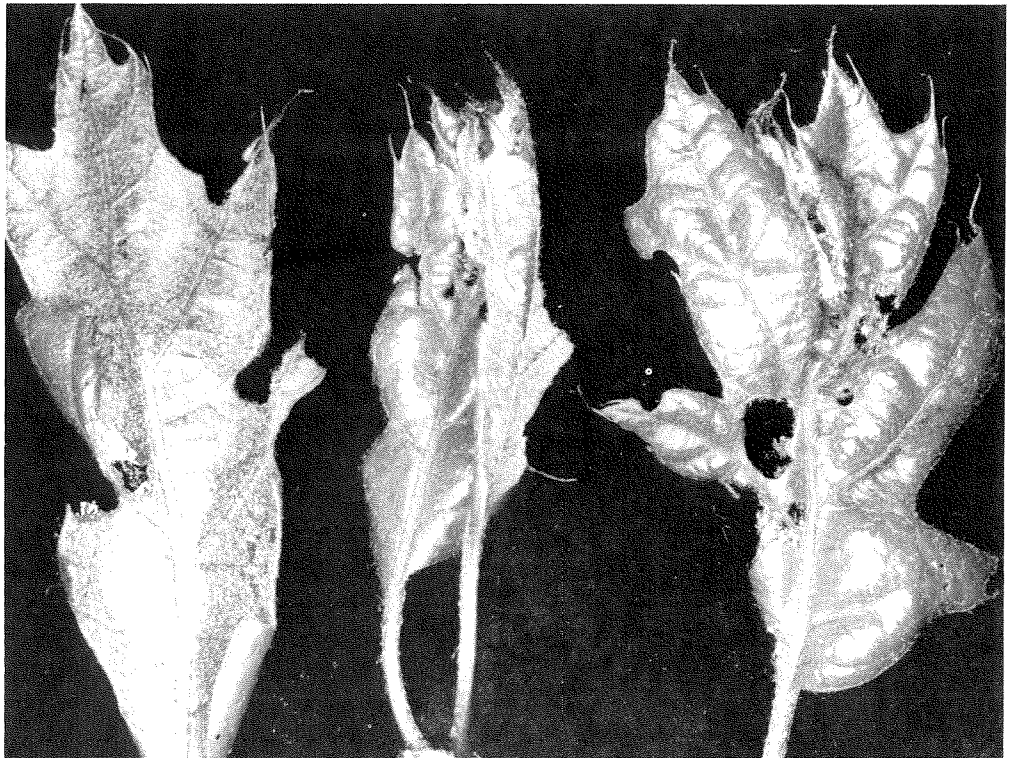
However, many defoliators do not make a structure. They are called “free feeders” and eat individually or in groups.



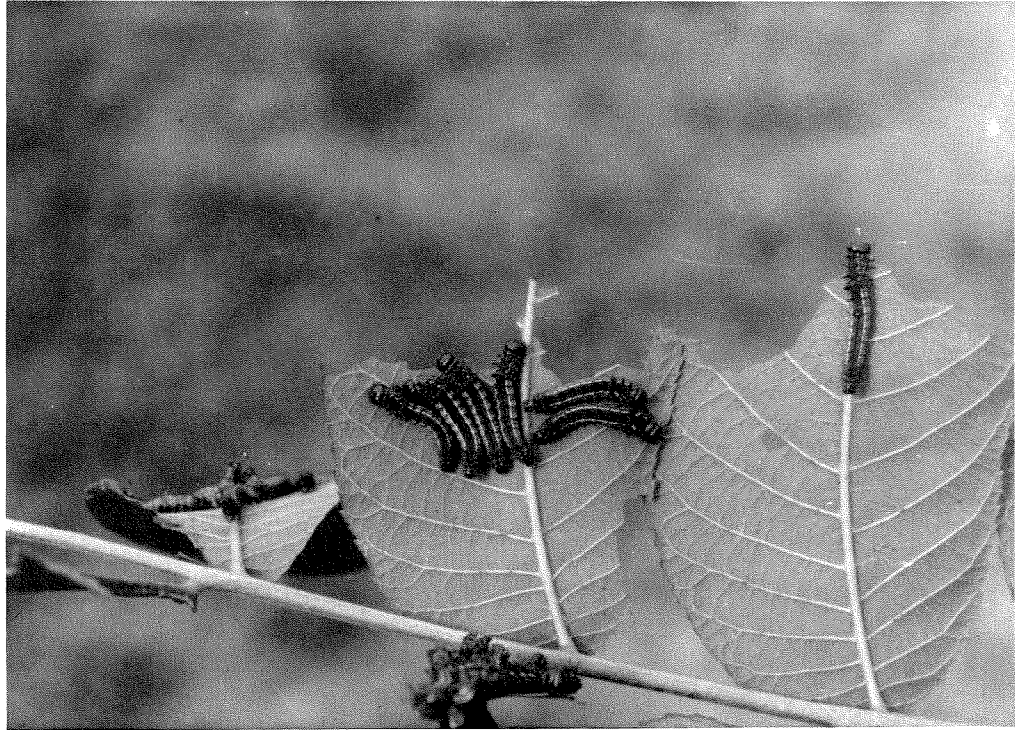
“Tent” feeding structure of the eastern tent caterpillar, *Malacosoma Americanum* (Fabricius). (James Hanson)



"Web" feeding structure of the fall webworm, *Hyphantria cunea* (Drury). (Philip Marshall)



"Roll" feeding structure of the oak leaftier, *Croesia semipurpurana* (Kearfott). (James Hanson)



A "free feeder," the redhumped caterpillar, *Schizura concinna* (J.E. Smith), feeds in groups and eats the whole leaf. (Philip Marshall)

Insect Order

Forest insect defoliators can be classified scientifically by the order of insect, such as Lepidoptera, Hymenoptera, Coleoptera, Orthoptera, and Diptera. Common names or examples of the forest insect defoliators of these orders are caterpillars, sawflies, beetles, walkingsticks, and miners, respectively.

Time of Feeding

Forest insect defoliators can be classified as spring defoliators, spring/summer defoliators, or summer defoliators. Spring defoliators feed from budbreak until mid- to late June. Spring/summer defoliators feed from late May or early June until July or August. Summer defoliators feed from late June or early July through September. Generally, the forest insect feeds only during one of the three periods, but there are a few forest insects that feed in two or more periods, such as oak sawflies. Each defoliation period has a different impact on the health of the defoliated trees.

Forest Damage

The damage to the forest is primarily done by the immature and not the adult stage of the insect. It is the caterpillars, larvae, maggots, and nymphs that

defoliate the trees in the various patterns described above. The extent of damage to a tree or forest depends on the amount of leaves eaten and the time of the growing season when defoliation occurs.

Direct damage, such as growth reduction, twig dieback, and mortality, begins when more than 60 percent of the foliage is eaten. At this level of defoliation, the tree may be forced to refoliate by expending food reserves. The new leaves are smaller, lighter green, and not as efficient in photosynthesis. The depletion of stored food and the decreased efficiency in photosynthesis weakens the trees and increases chances of attack and death from *Armillaria* root rot and attack by the two-lined chestnut borer. These secondary forest pests are the main reason that trees stressed from defoliation, drought, or other disturbances die 1 to 3 years later.

Defoliators also damage the forest environment indirectly. The loss of foliage can have negative impacts on the watershed value and indirectly lower water quality. Defoliation can alter wildlife habitat and change or shift wildlife composition. The nuisance of insects, especially overabundant caterpillars, also discourages forest recreation.

The time that defoliation occurs also influences the damage to the forest. Spring defoliators are more likely to cause mortality than spring/summer and summer defoliators. The amount of twig dieback and growth reduction may also be greater for spring defoliators. Spring defoliation occurs just when the tree has already expended food to form leaves. If the defoliation is greater than 60 percent, the tree refoliates and even more food reserves are depleted. The new leaves do not totally replace food reserves, resulting in a weak tree that has a greater chance of dying. Trees that do not refoliate and simply use the damaged, less efficient leaves to produce food, are less likely to die, even though growth is reduced and twigs die back.

Spring/summer and summer defoliated trees may not refoliate even if more than 60 percent of the leaves are eaten. By this time trees have already replaced the food used to form leaves at the start of the growing season. They are not as weak and have a greater chance to survive with less growth reduction and twig dieback.

How to Recognize Defoliation

Generally, you will not notice that a tree has been defoliated until more than 25 percent of the leaves have been eaten. The first symptom will be a change in crown color from green to yellow green then toward reddish brown. You may hear what sounds like rain in the woods even though it is not raining. This is the excrement of the insects falling through the forest canopy. You might also observe or mentally note that more light is penetrating the forest canopy or that something "looks" different about a tree or a forest. But, the best way to recognize defoliation is to observe the actual insect feeding on the foliage.

How to Recognize Forest Insect Defoliators

Caterpillars (Lepidoptera) cause the most defoliation. Caterpillars are wormlike insects, from less than 1 inch to more than 3 inches long, with segmented bodies. They have one pair of legs on the 3 segments behind the head and one pair of legs on 2 to 5 of the remaining body segments. Color, markings, and degree of hairiness varies.

Sawfly larvae (Hymenoptera) are also common defoliators. They look like caterpillars except that more body segments have a pair of legs. They feed together in colonies.

What to do About Defoliators

First, with local or regional expert help, determine if there is a need to do anything based on economic and biological analysis, and forest management goals and objectives. From an economic standpoint the value of the timber resource and the potential mortality should exceed the cost of preventing defoliation. Biologically speaking, spring defoliators need greater consideration for control measures than the spring/summer or summer defoliators. Your management goals or objectives may or may not dictate the need for actions to prevent defoliation. There are several options to consider.

Option - Do Nothing

This option is more appropriate for the spring/summer and summer defoliators. Forest management goals may also favor this option. Biological evaluation of the insect population could also suggest that you do nothing, especially if the population will collapse from natural causes. Economic analysis may also show that the resource value protected is less than the cost of treatments.

Option - Prevent or Suppress Defoliation

This option will more likely be selected when spring defoliators are involved, and when biological and economic analysis indicate the insect population and defoliation will increase the next growing season or that the resource is vulnerable and highly valuable. The primary tool of this option is insecticides, either biological or chemical, applied by air. Silvicultural tools include harvesting timber and doing timber stand improvement, which alter forest composition to reduce future defoliation and improve the health and vigor of residual trees. Occasionally, both insecticides and silvicultural treatments are needed. To help determine if prevention/suppression are needed, consult with your local or regional forest pest specialist.

Option - Monitor the Forest Insect Population

Many forest insect defoliators have parasites and predators that help to control them. Monitoring surveys can (1) determine if the parasites and predators are providing or will provide adequate control, and (2) help predict the next season's defoliation potential.

Option - Integrated Pest Management (IPM)

The above options, analysis, and surveys can be combined into an approach called *Integrated Pest Management* or IPM. Under IPM, information on the pest and the above options can be incorporated into the management plan for the particular forest. IPM encourages more careful consideration of all aspects of forest insect defoliators and their relationship to specific forest environments and their potential for modification.

Expert Help is Available

Contact forestry experts or your state forest pest specialist for current information and assistance with the forest insect defoliators that may threaten your area. The references listed below will provide additional information on forest insect defoliators of the central hardwoods and assist you in their identification.

References

- Department of Environment, Canadian Forestry Service. 1982. Insects of eastern hardwood trees. For. Tech. Rep. 29. Sault Ste. Marie, ON: Great Lakes Forestry Research Center. 304 p.
- Johnson, Warren T.; Lyon, Howard H. 1976. Insects that feed on trees and shrubs. Ithaca, NY: Cornell University Press. 464 p.
- U.S. Department of Agriculture. 1978. Gypsy moth handbook: major hardwood defoliators of the eastern United States. Home Garden Bull. 224. Washington, DC: Combined Forest Pest Research Development Program. 22 p.
- U.S. Department of Agriculture, Forest Service. 1979. A guide to common insects and diseases of forest trees in the northeastern United States. NA-FR-4. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 123 p.
- U.S. Department of Agriculture, Forest Service. 1980. Oak pests: a guide to major insects, diseases, air pollution and chemical injury. Gen. Rep. SA-GR1 1. Atlanta, GA: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 69 p.
- U. S. Department of Agriculture, Forest Service. 1985. Insects of eastern forests. Misc. Publ. 1426. Washington, DC: U.S. Department of Agriculture, Forest Service. 608 p.

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