RESEARCH NOTE NC-10

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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The Impact of Insects in the Northern Hardwoods Type

The northern hardwoods type occupies about 16 percent — 8.2 million acres — of the commercial forest land in the Lake States. The timber has high unit values and represents about 42 percent of the total value of all the commercial forest in the region. Increasing values and markets for northern hardwoods in recent years have stressed the need for better quality in the finished product. Industry, therefore, is vitally interested in clear material, particularly for veneers and furniture stock and even for the relatively new use of the denser hardwoods for pulp. This interest, in turn, has focused attention on agents affecting growth and grade.

Until recently, the role of insects in the development, growth, and quality in this type either was not recognized or was considered of minor importance. Insects can and do play an important role, however, in limiting the production of high-quality trees; they serve as entrance courts for degrading pathogens, and cause crooks and other form defects as well as growth and grade reductions. Recent studies of "maple blight" in Wisconsin indicate that insects played an important role leading up to mortality of sugar maple in all age classes.

Existing information on insects in northern hardwoods has recently been reviewed.[1] This Note condenses some of that information, especially the material concerning sugar maple and yellow birch. The available data, though scanty, indicate that insects attack these species from regeneration to maturity. For ease in presentation, the type of insect damage has been placed in four stages of a tree's development.

1. Damage to seeds and natural reproduction that modifies future stand composition. This damage, however, may be obscured and attributed in later years to some other natural factor, such as a disease organism or deer browse.

2. Defects causing poor tree form in the early growth stages and resulting in reduced values as the stands develop.

3. Growth reduction leading up to tree mortality and deterioration (probably of greatest importance in stands approaching merchantability).

4. Defect and degrade affecting all stages of growth but most noticeable and of greatest importance in merchantable trees and logs.

Insect Injury to Sugar Maple and Yellow Birch

Seeds and reproduction.—There is little factual information on the impact of insect damage to seeds and reproduction in the northern hardwoods type and only a small amount on the occurrence of certain insect species. Moth larvae (*Proteoteras* sp.) can cause heavy losses in sugar maple seeds. Shigo and Yelenosky (1963) reported destruction of 50 percent of yellow birch seeds in the Northeast by a seed weevil (*Apion walshii*). Random samplings of yellow birch seed, collected in October 1965 at the Dukes Experimental Forest in northern Michigan, showed that about 48 percent of the seeds were damaged by moth and beetle larvae. Sugar maple reproduction may be girdled at the ground line by the sugar maple timber beetle (*Corthylus punctatissimus*); trees up to 6 feet in height may be killed, and when the stand density is low, regeneration can be adversely affected.

Form defects. — Insect attacks that cause form defects in young stands may escape notice at the time they occur; or the symptoms may be confused with those of some other agent. Attacks by the gall-making maple borer (*Xylotrechus aceris*) and the birch-and-beech girdler (*X. quadrimaculatus*) are quite common in young trees up to 2 inches d.b.h. The damage may not be evident until the stem breaks. A twig pruner (*Elaphidion villosum*) may seriously deform and retard the growth of young maple trees, particularly nursery stock. Kulman (1965) reported that destruction of the terminal bud by larvae of the moth, *Obrussa ocherfasciella,* caused forking and reduced total shoot growth. A recent study by Tigner[2] in Upper Michigan revealed that larvae of this and another moth,

[1] *Problem Analysis, "The Impact of Insects in the Northern Hardwoods Forest in the Lake States," by H. J. MacAloney. July 1965.*

[2] *Tigner, T. C. The wood-boring insects in sugar maple sapling stands in northern Michigan with special reference to their identification and possible long-term effect on tree form. Unpublished thesis in partial fulfillment of the requirements of the Degree of Master of Forestry, Univ. Mich. 1966.*

Proteoteras sp., destroyed more than 20 percent of current leader buds of sugar maple saplings.

Growth loss and deterioration. — Sugar maple and yellow birch are attacked by free feeders, skeletonizers, miners, rollers, and webworms. When feeding persists for several years, there may be a measurable reduction in radial increment; and complete defoliation for 2 or more years may kill the tree. Value losses in sugar maple and yellow birch are not available, but Duncan and Hodson (1958) reported a reduction in growth amounting to as much as 2¼ cords per acre in aspen stands attacked by the forest tent caterpillar (*Malacosoma disstria*). This periodic insect also feeds heavily on sugar maple.

Recently, heavy mortality of sugar maple of all sizes and ages occurred during a critical period in late July and early August in northern Wisconsin due to a complex relationship of two leaf rollers (*Sparganothis acerivorana* and *Acleris chalybeana*) and a webworm (*Tetralopha asperatella*) (Giese and Benjamin 1964). Contributing to the severity of damage were the shoe-string root rot, low stand density, severe late spring frosts, and a high proportion of sugar maple.

Skilling (1964), studying the effect of below-normal precipitation and insect defoliation on the development of maple blight symptoms, found that 2 years of heavy mechanical defoliation caused severe tree mortality.

The bronze birch borer (*Agrilus anxius*) contributes to postlogging decadence and death (Spaulding and MacAloney 1931, Hall 1933). Under forest conditions, attack begins in the exposed crowns, causing branch mortality; it progresses downward, and in the final stages of attack the bole may be completely girdled. Trees of low vigor, especially those suddenly exposed by heavy cutting, are especially vulnerable. Jensen and MacAloney (1949) suggested that partial cutting would lessen the hazards of postlogging decadence. This borer, probably as a secondary agent, was also associated with the recent birch dieback problem in the Northeast, which caused a loss of 494 million board feet of birch (Hepting and Jemison 1958). Environmental factors, chiefly climatic, were the direct cause of dieback.

Defect and degrade. — This type of damage is present in all northern hardwood species, but research gives information for insects on only one species — sugar maple. The two most important species attacking merchantable trees are the sugar maple borer (*Glycobius speciosus*) and the sugar maple cambium miner (*Phytobia setosa*). Larvae of the sugar maple borer construct extensive galleries in the wood, mostly in the lower part of the boles of trees above 6 inches d.b.h. Occasionally a stem will break, but reduction in value for flooring and furniture stock is the most important item. Talerico (1962), studying relatively young merchantable stands in northwestern Pennsylvania, found that attacks were most numerous in the codominant trees. The beetles are sunloving, and there was some evidence that trees of low vigor on the southerly aspects were more susceptible to attack.

The cambium miners — larvae of small flies — begin their attacks in the small, upper branches and mine downward into the roots between the bark and the cambium, causing pith ray flecks. These flecks are apparent deep in the wood, in cross-section cuts, years after the actual attack. Ward and Marden (1964) estimated losses as high as 13.6 percent of the monetary value of fleck-free face veneer. Hanson[3] stated that the grade loss had been conservatively estimated at 35 to 40 per cent of the value of face-grade veneer stock. Paneling with this defect, however, is popular in some markets.

Wormhole or pinhole defects in both maple and birch are caused by ambrosia beetles and may be characterized by stained burrows in the sapwood. The Columbian timber beetle (*Corthylus columbianus*), one of the most important in the Lake States, attacks living, vigorous sugar maples; but there is no published information on value losses. In the central hardwoods region, however, Wilson (1959) reported rejection of 30 percent of white oak logs intended for high-grade veneer. Timber worms and powder-post beetles are often associated with wounds or sunscald and increase the degrade problem, particularly in decayed areas.

On the whole, information on defect and degrade in yellow birch due to insect activity is lacking except as it refers to deterioration following death due to defoliation or girdling. Roughened areas on the bark can indicate attack by scale insects such as *Xylococculus betulae,* which may result in stem lesions and cracks, possible entrance courts for wood rots and cankers (Shigo 1962). Nectria cankers, for example, are commonly found on sugar maple and yellow birch.

Associated Tree Species

Brief mention should be made of insect injury to the more important tree species associated with sugar maple and yellow birch in the northern hardwoods type. The hemlock borer (*Melanophila fulvoguttata*) is essentially a secondary insect which may build up to tremendous populations in stands disturbed by natural factors or heavy logging. Following severe drought and windthrow in central Wisconsin about 30 years ago, this insect was an important factor in the mortality of about 135 million board feet of overmature hemlock; fortunately, much of this was salvaged. The hemlock looper (*Lambdina fiscellaria*) caused heavy mortality 35 to 40 years ago in Wisconsin and Upper Michigan in small acreages where hemlock was

[3] *Hanson, J. B. The biology of the sugar maple cambium miner,* Phytobia setosa *(Loew), and notes on other cambium miners in diffuse porous woods. Unpublished thesis in partial fulfillment of the requirements of the Degree of Master of Science, Univ. Wis. 1965.*

the predominant species. Economic conditions at that time precluded salvage of much of this dead material.

The red oaks and basswood are periodically attacked by the walkingstick (*Diapheromera femorata*). Fortunately, this insect is wingless, and spread is relatively slow. It also requires 2 years for development, and, unless alternate-year broods overlap, attack occurs every other year.

To date, beech has had comparatively little insect damage in the Lake States. Tree mortality, however, was widespread in trees of all ages in the Northeast between 1930 and 1950 due to attack by an imported insect, the beech scale (*Cryptococcus fagi*); and mortality is still continuing at lower levels. A fungus (*Nectria coccinea* var. *faginata*) attacks the infested trees 3 to 5 years after the scale becomes apparent and hastens tree mortality. The scale, *Xylococculus betulae,* also attacks beech, causing damage similar to that in yellow birch.

Research Needed

Some insect buildups appear to be associated with stand conditions that are altered by management or logging or by natural factors such as windthrow. Where this occurs, an integration of management practices with knowledge of insect behavior would be a fruitful approach.

Other insect outbreaks are periodic and associated with environmental or climatic factors rather than management or stand conditions. Here research should be aimed at gaining a knowledge of the factors which may "trigger" a condition suitable for development of an infestation. Studies of population dynamics may provide key factors which could be exploited for control.

Literature Cited

Duncan, D. P., and Hodson, A. C.
1958. Influence of the forest tent caterpillar upon the aspen forests of Minnesota. Forest Sci. 4: 71-93, illus.

Giese, Ronald L., and Benjamin, Daniel M.
1964. The insect complex associated with maple blight. Part II. *In* Studies of Maple Blight. Univ. Wis. Agr. Exp. Sta. Res. Bull. 250: 2-57, illus.

Hall, R. C.
1933. Postlogging decadence in northern hardwoods. Univ. Mich. Sch. Forest. Conserv. Bull. 3, 66 pp., illus.

Hepting, George H., and Jemison, George W.
1958. Forest protection. *In* Timber Resources for America's Future. U.S. Forest Serv. Forest Resource Rep. 14: 185-220.

Jensen, Victor S., and MacAloney, Harvey J.
1949. Recovery of birch fifteen years after partial cutting. Soc. Amer. Foresters Proc. 1948: 298-302.

Kulman, H. M.
1965. Effects of disbudding on the shoot mortality, growth, and bud production in red and sugar maple. J. Econ. Entomol. 58: 23-26.

Shigo, Alex L.
1962. Another scale insect on beech. U.S. Forest Serv., Northeast. Forest Exp. Sta., Sta. Paper 168, 13 pp., illus. Upper Darby, Penn.

Shigo, Alex L., and Yelenosky, George.
1963. Fungus and insect injury to yellow birch seeds and seedlings. U.S. Forest Serv. Res. Pap. NE-11, 11 pp., illus. Northeast. Forest Exp. Sta., Upper Darby, Penn.

Skilling, Darroll D.
1964. Ecological factors associated with maple blight. Part V. *In* Studies of Maple Blight. Univ. Wis. Agr. Exp. Sta. Res. Bull. 250: 115-129, illus.

Spaulding, Perley, and MacAloney, H. J.
1931. A study of organic factors concerned in the decadence of birch in cut-over lands in northern New England. J. Forest. 29: 1134-1149, illus.

Talerico, R. M.
1962. A study of damage caused by the sugar maple borer. J. Forest. 60: 178-180, illus.

Ward, James C., and Marden, Richard M.
1964. Sugar maple veneer logs should be graded for pith flecks. U.S. Forest Serv. Res. Note LS-41, 4 pp., illus. Lake States Forest Exp. Sta., St. Paul, Minn.

Wilson, Charles L.
1959. The Columbian timber beetle and associated fungi in white oak. Forest Sci. 5: 114-127, illus.

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