IMPACT OF BARK AND AMBROSIA BEETLES (SCOLYTIDAE) ON INDIANA HARDWOODS

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ABSTRACT

Scolytid beetles are abundant and diverse in stands of Indiana hardwoods. Analysis of the pest status of these scolytids shows only a few present or potential pests. There are a few species of ambrosia beetles that damage live trees or the wood of cut trees. There are a few bark beetles that have the capacity to kill live trees, including two species that cause widespread mortality of forest trees. It is expected that hardwood scolytids will remain relatively benign unless certain types of scolytid-borne diseases appear.

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Introduction

Epidemics of scolytid beetles in coniferous forests are classified, along with fire, budworm outbreaks, overgrazing of sheep and cattle, among the great natural and unnatural disasters that threaten the forests. In hardwood forests this same group of insects appears to include only minor pests. This contrast invites inquiries, particularly in view of the indiscriminate virulence of most major groups of forest pests. Is there a lack of scolytids in hardwood forests, or are hardwood scolytids more benign than those in conifers? How many species of hardwood scolytids are current pests; how many species are potentially destructive? Does the species diversity of natural hardwood stands play a part in the prevention of epidemics? Answers to these questions were sought during the summer of 1978 in a survey of the bark and ambrosia beetles of Indiana.

Diversity of Indiana Scolytids

Systematic collecting quickly showed that scolytids were abundant and diverse in forests and woodlots throughout the state. The survey produced 65 species of scolytids, including 25 species not previously reported from Indiana. There were 45 species found in hardwood hosts. It is probable that hardwood forests of Ohio and Illinois harbor a similar scolytid fauna, although there have been no surveys in those states.

Criteria for Determining Pest Status

For the purposes of this study the following critera were developed to determine the pest status of each species. The application of these criteria remains subjective as it was not practical to devise the 45 sampling systems needed for quantitative analysis.

Table 1: Pest Categories of Indiana. See text for definition of categories.

1 (A,B,C)
Scolytus rugulosus Ratzeburg
S. multistriatus Marsham
S. quadrispinosus Say
Xylosandrus germanus (Blandford)
Monarthrum fasciatum (Say)
Corthylus columbianus Hopkins

2 (A,B)
Scolytus muticus Say
Leperisinus fasciatus (LeConte)
Xyloterinus politus (Say)
Xyleborus sayi (Hopkins)
X. dispar (Fabricius)
X. saxeseni (Ratzeburg)
X. celsus Eichhoff
X. ferrugineus (Fabricius)
X. xylographus (Say)
X. affinus Eichhoff
Monarthrum mali (Fitch)
Corthylus punctatissimus Zimmerman

3 (A,C)
Leperisinus aculeatus (Say)
Phloeotribus dentifrons (Blackman)
P. liminaris Harris
Chramesus hicoriae LeConte
Stephanoderes dissimilis (Zimmerman)
S. interstitialis Hopkins
Pseudopityophthorus minutissimus (Zimmerman)
P. asperulus LeConte
Pityophthorus rhois Swaine

4 (B,C)
Pityophthorus crinalis Blackman
P. virilis Blackman

5 (A)
Lymantor decipens LeConte
Trischidias atoma (Hopkins)
Leperisinus pruinosus (Eichhoff)
Chramesus chapuisii LeConte
Thysanoes fimbricornis LeConte
Hylocurus rudis (LeConte)
Stephanoderes rotundicollis Eichhoff

6 (B)
Phloeotribus frontalis Oliver

7 (C)
Micracis swainei Blackman
M. suturalis LeConte
Hypothenemus eruditus Westwood

8 (none)
Pityophthorus natalis Blackman

A. The host tree species must be an important forest tree. The host should preferably be of some importance in production of wood products, but usefulness in watershed, wildlife, or recreational management is also taken into account. The rather short list of hosts that do not qualify as "important" includes Rhus aromatica Ait., Morus rubra L., Cornus rugosa Lam., Cercis canadensis L., and Rhododendron sp.

B. The host tree must be severely injured or deformed directly or indirectly by the scolytid attack. Killing of twigs is not considered significant unless leading shoots or nursery stock are regularly damaged. Included as severe damage are attacks by ambrosia beetles on cut logs.

C. Large numbers of trees must be attacked by either an endemic or epidemic population of the scolytid.

Pest Status of Indiana Scolytids

The criteria listed above allow scolytids to be grouped in eight categories (Table 1) including a category for species that meet none of the criteria.

1. (A,B,C) This category includes the six species that are the most serious scolytid pests of midwestern hardwoods. Examples are Scolytus multistriatus Marsham, the vector of Dutch elm disease, and Monarthrum fasciatum (Say), an ambrosia beetle.

2. (A,B) Of the twelve species in this category, eleven are ambrosia beetles. This category includes several potential pests, such as Xyleborus saxeseni (Ratzeburg), a very common Indiana ambrosia beetle that is a minor pest in Florida (Bright 1968).

3. (A,C) This category includes nine species, most of which occur in twigs or small branches. A representative species is Phloeotribus dentifrons (Blackman), which kills twigs of Celtis spp.

4. (B,C) This category includes only two species. One of these, Pityophthorus crinalis Blackman, may be considered a beneficial insect as it injures or kills Rhus radicans L.

5. (A) Most of the seven species in this category attack branches and twigs. An example is Pseudothysanoes rigidus (LeConte), a relatively uncommon species found in small branches of fallen Tilia americana L.

6. (B) This category includes only one species, Phloeotribus frontalis Oliver; this species apparently mass-attacks and kills small suppressed Morus rubra L. in young mixed stands.

7. (C) This category includes three species; an example is Micracis suturalis LeConte, a common species usually found in small dead Cercis canadensis L.

8. This category includes only the uncommon Pityophthorus natalis Blackman, which breeds in dying Cercis canadensis L.

Ambrosia Beetles as Pests of Indiana Hardwoods

Scolytid pests of hardwoods may be divided into two biologically divergent groups, the ambrosia or timber beetles, and the bark beetles. Ambrosia beetles differ from bark beetles in their feeding habits, in their range of hosts, in geographic distribution, and in the damage they cause.

Ambrosia beetles normally make galleries in living or recently killed trees, cultivating a symbiotic fungus along the sides of the gallery. Both adults and larvae feed exclusively on special fruiting bodies that are induced to grow from the fungus.

Each species of ambrosia beetle is able to breed in a number of species of host trees; the hosts of many ambrosia beetles include all available hardwoods. Because ambrosia beetles feed on nutrients that have been gathered and concentrated from the surrounding wood and transformed into a uniform product of the fungus, ambrosia beetles are probably subject to relatively little adaptive pressure to become specialized to deal with the nutritional peculiarities of the tissues of a particular genus or species of tree. A study of the fungi cultivated by ambrosia beetles shows that a species of beetle may cultivate and subsist on several species of fungus (Batra 1966), possibly giving ambrosia beetles yet more flexibility in their choice of tree species to serve as a fungal substrate. The adaptive position of ambrosia beetles may actually be improved with increasing diversity of forest stands, and in the extraordinarily heterogeneous forests of the lowland tropics ambrosia beetles are very much the dominant scolytids. Ecological diversity among ambrosia beetles is apparently maintained chiefly by preferences for material of a particular size, moisture content, exposure to sunlight, and state of health or decomposition of the host. Management problems with ambrosia beetles, therefore, may seemingly appear unpredictably without a previous history of infestation of the host species.

Ambrosia beetle damage to cut or fallen timber consists of "pin-holes," usually extending deep into the sapwood and surround-d by a conspicuous black stain. Ambrosia beetles seldom attack in sufficient numbers as to cause structural weakening, but even in a few holes in a plank or veneer log can cause a drastic reduction in value (Johnson 1958). It might be mentioned paranthetically that imitation wood often has printed on it not only the grain but also the galleries of ambrosia beetles to enhance the "naturalness." The only instances observed during 1978 of ambrosia beetles attacking logs heavily were infestations of *Monarthrum fasciatus* (Say) together with smaller numbers of *M. mali* (Fitch) in *Quercus alba* L.

Certain ambrosia beetles also attack live trees. The Columbian timber beetle, Corthylus columbianus Hopkins is a well known pest in midwestern hardwoods, frequently attacking and scarring live trees (Kabir and Giese 1966). This species was seldom observed during the present study, but is retained on the list of pest species as there are sporadic outbreaks in the Midwest (Kabir and Giese 1966). The only abundant ambrosia beetle found in live hosts during the present study is the introduced Xylosandrus germanus (Blandford). This species was found on several occasions in young Juglans nigra L. and once in Rhododendron spp. Distribution maps (Bright 1968), and collecting records suggest that this species has only recently become widespread in Indiana. A closely related species has become a serious pest of shrubs in Florida (Bright 1968).

Bark Beetles as Pests of Indiana Hardwoods

Bark beetles feed on the bark or wood of their host. Only those species that feed on bark are able to kill trees. Bark beetles tend to be specialists, feeding on a single genus or species of host. The devastating effects of bark beetles in conifer forests may be largely attributable to the relatively low diversity in natural stands of conifers. Conversely, the apparently benign nature of hardwood bark beetles must be related to the high diversity of natural hardwood stands. This diversity not only suppresses and fragments populations of hardwood bark beetles, but also masks the effects of outbreaks. Planting of large numbers of a single hardwood genus, Ulmus, for example, can in some cases contribute to an epidemic of bark beetles, but even if all hardwoods were grown in monocultures there would probably be few bark beetle epidemics in the near future: mass attacks by bark beetles overwhelming healthy trees are complex and precisely choreographed operations that must take a long time to evolve.

There are at least three bark beetles that may be considered pests of Indiana hardwoods. All of these belong to the genus Scolytus, but are remarkably dissimilar biologically.

Scolytus rugulosus Ratzeburg is a European species introduced into North America at an early date and long associated with agriculture. The hosts are Prunus and other trees in the Rosaceae. A variety of material, from small branches to boles at least 14 cm are attacked. Injured or severely stressed material is normally attacked, but a small patch of dead bark may be colonized and enlarged until a bole or limb is girdled. The ability to breed in numerous host species and in a variety of host material ensures persistently high populations of S. rugulosus. This species is usually considered a pest of orchard and ornamental trees, but during the present study Prunus serotina Ehrh., P. pensylvanica L. and P. virginiana L. were to be occasionally attacked when these trees were growing on the edges of stands.

Scolytus quadrispinosus Say is a native species attacking all members of the genus Carya. This is one of the few hardwood scolytids showing the attack pattern of conifer scolytids: a pheromone-mediated mass attack that overwhelms groups of mature trees, usually trees that are drought stressed (Goeden and Norris 1965). Thousands of trees are killed during epidemics in the Northeast and Midwest (Chamberlin 1939). Although S. quadrispinosus occurs throughout southern Indiana, no recently attacked trees were found during the summer of 1978.

Scolytus multistriatus Marsham is an introduced European species achieving importance as the principle vector of Dutch elm disease, Ceratocystus ulmi. Due to the lack of coevolution between the Asiatic fungus, the European beetle, and North American elms, host utilization by S. multistriatus is not efficient. The fungus is spread by adult beetles feeding in the bark of twigs of healthy trees; not all the trees attacked and killed in this way are suitable breeding hosts for S. multistriatus. At the present rate of destruction of elm trees it might be expected that all suitable hosts would be eliminated, followed by the extinction of the insect vector and the return of native elms, but the presence of disease-resistant naturalized Asiatic trees to serve as alternate hosts for S. multistriatus may prevent the eradication of disease and vector in Indiana.

Scolytus multistriatus is not the only scolytid with the ability to spread disease to healthy trees. All species of *Scolytus*, *Leperisinus*, and *Phloeotribus* bore into healthy trees for maturation feeding or construction of overwintering galleries. If supplied with suitable pathogens these scolytids would be able to spread epidemics through all midwestern species of *Fraxinus*, *Carya*, *Celtis*, *Prunus*, *Malus*, *Crataegus*, and *Morus*.

Summary

Scolytid beetles are abundant and diverse in stands of Indiana hardwoods. Analysis of the pest status of these scolytids shows only a few present or potential pests. There are a few species of ambrosia beetles that damage live trees or the wood of cut trees. There are a few bark beetles that have the capacity to kill live trees, including two species that cause widespread mortality of forest trees. It is expected that hardwood scolytids will remain relatively benign unless certain types of scolytid-borne diseases appear.

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