Beyond the Asian Longhorned Beetle and Emerald Ash Borer

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Abstract: The Asian longhorned beetle (*Anoplophora glabripennis*) and emerald ash borer (*Agrilus planipennis*) are exotic forest insects that have had severe impacts on host tree species where they have become established in North America in recent years. Several other exotic forest arthropods have also appeared recently in North America, but have gained less notoriety. Although their potential impacts are less, the full extent of their impacts remains unknown. Some examples of these other exotic arthropod species are the granulate ambrosia beetle (*Xylosandrus crassiusculus*), banded elm bark beetle (*Scolytus schevyrewi*), European wood wasp (*Sirex noctilio)*, and a predatory itch mite (*Pyemotes herfsi*).

Keywords: invasive species, *Xylosandrus crassiusculus,* Asian ambrosia beetle, *Scolytus schevyrewi*, *Sirex noctilio*, *Pyemotes herfsi*, bark beetle, wood wasp, wood borers, itch mite

Introduction

Threats from exotic species of forest arthropods have been increasing in recent years. The gypsy moth (*Lymantria dispar*) has long been a component of northeastern U.S. forests and continues to expand its range into Midwestern States. More recently, the Asian longhorned beetle (*Anoplophora glabripennis*) and the emerald ash borer (*Agrilus planipennis*) have had devastating impacts on susceptible host trees where these insects have become established in North America.

The Asian longhorned beetle is a large wood-boring beetle that attacks and kills maples (*Acer* spp.), horsechestnut (*Aesculus* spp.), willows (*Salix* spp.), elms (*Ulmus* spp.), and several other hardwood species. Established populations have been discovered in New York (1996), Illinois (1998), New Jersey (2002), and Ontario (2003) (CFIA 2005; UV ERL 2005; USDA APHIS PPQ 2005a). Eradication efforts have been undertaken for all identified populations. Results of these efforts have been particularly promising in Chicago, IL, where portions of the Asian longhorned beetle quarantine area were deregulated in April 2005.

The emerald ash borer, a wood-boring beetle native to Asia, was detected in 2002 in southeastern Michigan and southern Ontario (Cappaert and others 2005). This insect appears capable of killing all ash (*Fraxinus* spp.) trees it encounters in eastern North America. Several million ash trees have died in six counties in southeastern Michigan. Additional emerald ash borer populations have been detected across the lower peninsula of Michigan and in scattered locations in northwest Ohio and northeast Indiana. A huge multi-agency effort is underway to detect the beetle's distribution and attempt to limit its spread to new areas.

In addition to these well-known species, several other exotic forest pests have been detected in the northeastern U.S. in recent years. They have not achieved the notoriety of the above insects, and most are not likely to reach that level. But the full extent of their potential impacts is unknown. Like the Asian longhorned beetle and the emerald ash borer, several of these insects tunnel under tree bark and into wood and are thought to have entered the U.S. by hitchhiking in solid wood packing materials. Some of these new species have the potential for serious impacts on forest resources.

Granulate Ambrosia Beetle

The granulate ambrosia beetle (*Xylosandrus crassiusculus*), also known as the Asian ambrosia beetle, was first detected in South Carolina in 1974 and spread rapidly throughout the southeastern U.S. (Solomon 1995; Hopkins and Robbins 2005). This wood-boring beetle is now frequently observed in some Midwestern States. It is native to Africa, southern Asia, Indonesia, Australia, and Pacific islands, and attacks a wide variety of broadleaf trees and shrubs.

The black stem borer (*X. germanus*), a closely related ambrosia beetle, was first detected in 1932 in Long Island, NY (Solomon 1995). A native of eastern Asia and central Europe, this beetle is now distributed throughout the eastern U.S. It also attacks a wide array of broadleaf hosts, but will attack some conifers.

These beetles attack by tunneling into the sapwood and constructing branched galleries. An interesting characteristic of attacks by both of these beetles is the presence of "frass toothpicks" or cylindrical strands of excrement and wood particles protruding from the bark. These strands are not present with all attacks, but can be a clear indicator of the presence of one of these beetle species.

Like other ambrosia beetles, the granulate ambrosia beetle and the black stem borer do not feed on the wood of their host tree, but feed on an ambrosia fungus that they introduce into their galleries. Pathogenic fungi (*Fusarium* spp.) may also be introduced or enter beetle galleries and infect the host plant. Unlike other ambrosia beetles, both of these species are rather aggressive and will attack healthy as well as stressed trees. Damage to hosts can be severe and sometimes fatal. The granulate ambrosia beetle was frequently reported damaging and sometimes killing young ornamental and fruit trees across central Arkansas in spring 2005.

The granulate ambrosia beetle is known to attack at least 13 broadleaf species in North America, with some preference shown for sweetgum (*Liquidambar styraciflua*) (Solomon 1995; Atkinson and others 2005). In May 2005, this insect was identified as infesting black walnut (*Juglans nigra*) trees in a southwest Missouri plantation (R. Lawrence, personal observation). This may be one of the first reports of this insect attacking walnut. During 2002 to 2005, frass toothpicks were observed in Missouri on American elm (*Ulmus americana*), sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), Japanese maple (*Acer palmatum*), yellow poplar (*Liriodendron tulipifera*), northern red oak (*Quercus rubra*), goldenrain tree (*Koelreuteria paniculata*), and Chinese chestnut (*Castanea mollissima*) (reports received by the Missouri Department of Conservation). Identities of the specific ambrosia beetles involved were not determined in these cases. In another case, granulate ambrosia beetles were observed attacking a recently carved white pine totem pole in western Missouri in 2002.

Reducing stress on recently planted or nursery trees is important in reducing attacks by the granulate ambrosia beetle. This insect has multiple generations per year. Heavily attacked branches or whole trees should be removed and destroyed to prevent infestations of nearby trees.

Banded Elm Bark Beetle

The banded elm bark beetle (*Scolytus schevyrewi*), a native of central and eastern Asia, was first detected in the U.S. in 2003, attacking and apparently killing elms in Colorado and Utah. The beetle has since been found in over 20 states across the country from California to New Jersey (NAPIS 2004; Negrón and others 2005). In Asia, it attacks elms, weeping willow (*Salix babylonica*), Russian-olive (*Elaeagnus angustifolia*), peashrub (*Caragana* spp.), various *Prunus* species, apple (*Malus* spp.), almond (*Prunus amygdalus*), and others. Thus far, it has been observed attacking only four species of elms in the U.S. (*Ulmus americana*, *U. pumila*, *U. thomasii*, and *U. procera*).

The full impacts of this introduced species are unknown. It is apparently capable of directly attacking and killing mature, drought-stressed elms (Witcosky 2004; Negrón and others 2005), although it is not clear if this beetle can also attack and kill healthy trees. Attacks on fruit trees (*Prunus* spp.) have not yet been reported in the U.S. Nursery and orchard workers should be alert for possible attacks by this new beetle species. The adult banded elm bark beetle is about 3 to 4 mm long and has a dark brown transverse band across a lighter brown upper surface.

The banded elm bark beetle is closely related to the smaller European elm bark beetle (*S. multistriatus*) that vectors Dutch elm disease (DED). Researchers have isolated DED spores from some banded elm bark beetles, although it has not yet been demonstrated that they can act as vectors of the disease (Negrón and others 2005). Many questions remain about whether the banded elm bark beetle might be a more efficient DED vector than the smaller European bark beetle, and how competitive interactions between the two beetle species might affect elm mortality.

It is interesting to note that this beetle already had a transcontinental distribution at the time of its detection in the U.S. The beetle apparently has been present in the U.S. for at least 10 years (Negrón and others 2005), and perhaps several more. Detection of the beetle may have been delayed because its impacts were masked by the continuing loss of elms across the landscape that has been ascribed to DED. It is unknown how much, if any, of this mortality was caused by DED vectored by the banded elm bark beetle, or how much elm mortality was perhaps caused by the beetle directly without the presence of DED. Researchers are continuing to study the biology, ecology, and impacts of the banded elm bark beetle (Negrón and others 2005).

European Wood Wasp

An established population of the European wood wasp (*Sirex noctilio*) was detected near Oswego, NY, in 2005 (Eggert and Dunkle 2005). In its native range in Europe, Asia, and North Africa, this wood-boring insect is considered a secondary pest of pines (*Pinus* spp.). But where this insect has become established in other areas (Australia, New Zealand, South America, and South Africa), it is a serious pest in plantations of exotic pines, particularly North American pine species (Haugen and Hoebeke 2005).

There are several species of wood wasps (or horntails) native to North America that attack conifers, however most of these species primarily attack dead or dying trees (USDA FS 1985). The European wood wasp is a much more aggressive pest of North American pine species. Relatively healthy but stressed pines can be heavily attacked. The female wood wasp drills into a stressed tree with her ovipositor and inserts a symbiotic fungus, toxic mucus, and eggs into the wood. The fungus and mucus act together to cause the death of the tree, resulting in a suitable environment for development of wood wasp larvae (Haugen and Hoebeke 2005). Surveys are being conducted to determine the extent of the wood wasp infestation in New York (USDA APHIS PPQ 2005b). An effective biological control agent is available for

use in managing European wood wasp populations. A parasitic nematode (*Deladenus siricidicola*) is capable of infecting wood wasp larvae and sterilizing female adults (Haugen and Hoebeke 2005).

Pyemotes Itch Mites

Not all introduced arthropods that become established on U.S. trees are plant pests. Numerous reports of unseen biting creatures were received by various agencies in Kansas, Nebraska, Missouri, and Texas in late summer and fall 2004. People were complaining of welt-like bites particularly on upper portions of the body, which differed from chigger bites, were associated with outdoor activity, and were commonly associated with raking oak leaves. The culprit was eventually determined to be an itch mite (*Pyemotes herfsi*), an exotic species of a predatory mite that preys on moth larvae in its native range in Europe and has often been reported to bite humans (Peter 2004; Keith and others 2005).

In the U.S., *P. herfsi* preys on midge larvae within oak leaf galls, especially the marginal fold gall on pin oaks. This predatory mite has multiple generations per year and is capable of rapidly building large populations when conditions are favorable (Keith and others 2005). When mature gall larvae drop from oak leaves in late summer, the mites begin dispersing in "mite showers" from trees. The incidence of bites is high for people involved in outdoor activities during these "showers" in late summer and later in fall when raking leaves. This introduced species obviously has an annoying impact on human activities around oaks. But beyond that are the unknown ecological impacts that this species may have on gall insects, other predatory mites, and the relationships of these arthropods with other organisms.

Monitoring and Management Implications

It is obvious from the widespread distribution of some exotic forest insect species recently discovered in North America that these insects were introduced several years ago. In some cases, large numbers of trees have been killed before the new invader has been detected. Increased monitoring and increased awareness of this problem are vitally important for conserving the health of our forests.

Detection monitoring efforts have increased in recent years. For example, the USDA Animal and Plant Health Inspection Service, USDA Forest Service, and various State partners are implementing "early detection and rapid response" programs (USDA FS 2004; USDA APHIS PPQ 2005c). A major part of these efforts thus far has involved the use of trapping surveys to detect exotic wood borers and bark beetles. The banded elm bark beetle and European wood wasp infestations in the U.S. were first detected through these surveys (Negrón and others 2005; USDA APHIS PPQ 2005b).

Along with detection monitoring is the need for education efforts. Raising awareness among forestry professionals and the general public about specific exotic pest threats can greatly enhance early detection. Arborists, nursery workers, foresters, and others who work daily with trees may often be the first persons to detect newly introduced pests. Increasing public awareness of key pathways of introduction of exotic pests (for example, long-distance movement of firewood) and how to reduce risk of introductions to new areas is also very important.

Although it is impossible to manage forests to completely defend against unknown exotic pest threats that suddenly appear, reinforcement of some forest management principles can greatly help. Increasing tree species diversity can potentially reduce the impacts of new pests. Although some exotic pests, such as gypsy moths (*Lymantria dispar*), are generalists in their feeding habits, host species diversity can still be beneficial. Oak defoliation and mortality due to gypsy moths are lower in stands with greater species diversity. In the case of specialist pests such as the emerald ash borer or Dutch elm disease, maintaining species diversity is important to provide a residual forest in the event that the specialists eliminate much of a single tree species. Some Chicago neighborhoods affected by the Asian longhorned beetle have been unfortunate examples of the risk of planting monocultures (Korab 2000). Elms lining the streets of the neighborhoods were killed by Dutch elm disease many years ago. Rows of Norway maples (*Acer platanoides*) planted to replace the elms have now been decimated by the Asian longhorned beetle.

Another important principle is the obvious one of improving and maintaining forest health. Trees that are vigorous, growing on appropriate sites, and not stressed by biotic or abiotic conditions are much more capable of defending themselves against pest attacks. For example, management of the oak decline complex in Missouri often involves harvesting the more drought-susceptible red oak species and increasing the more drought-tolerant pine component on drier sites, where a larger pine component was historically present many decades ago. By improving forest health in terms of oak decline, managers simultaneously will be taking steps that will help reduce the forests' susceptibility to the gypsy moth and other pests that will eventually arrive in Missouri.

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