Emerald Ash Borer Pest Risk Assessment

Identity
Scientific Name: *Agrilis planipennis* Fairmaire
Phylum: Arthropoda
Class: Insecta
Family: Buprestidae
Common Name: Emerald ash borer (EAB)

Relative Risk Rating: VERY HIGH

Uncertainty: Low

Pest Background:
The emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, is a member of the family of flat-headed, metallic-colored woodborers, often called jewel beetles. It is native to Asia and is known to occur in China, Korea, Japan, Mongolia, the Russian Far East and Taiwan (Haack et al. 2002). It was first discovered causing damage to ash trees in North America in 2002, in southeastern Michigan, and research has shown that it represents a significant threat to all 16 true ashes (*Fraxinus* spp.) that occur here (Dobesberger 2002; Liu et al. 2003). Unlike the majority of woodborers, it readily attacks and kills vigorous, healthy ash trees of all size classes (McCullough and Roberts 2002), and thus poses a tremendous ecological and economic threat to both urban and natural ash resources of many states, including Oregon (Wei et al. 2004).

Emerald ash borer is thought to have arrived in the United States in the late 1990's on solid wood packing materials located aboard cargo ships or airplanes originating in Asia (McCullough and Roberts 2002). From Michigan, EAB spread to Windsor, Ontario, and was then found in Ohio in 2003, northern Indiana in 2004, northern Illinois and Maryland in 2006, western Pennsylvania and West Virginia in 2007, Wisconsin, Missouri and Virginia in 2008, and Minnesota and Kentucky in 2009 (Figure 1).

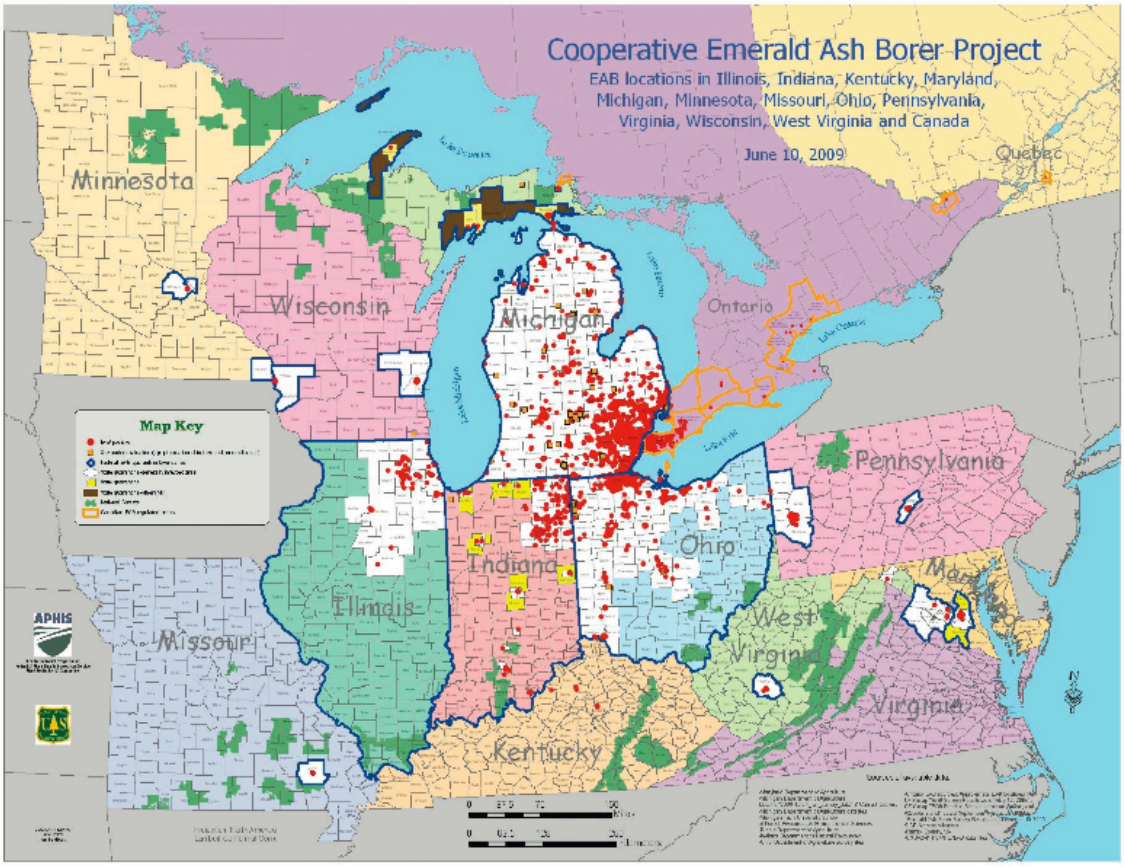

Figure 1. Distribution of EAB detections. USDA APHIS and USFS 2009.

Since its discovery, EAB has shown the ability to rapidly spread to new areas and is responsible for killing millions of ash trees in those areas where it has become established. The adult beetles feed on ash foliage causing little damage, while the larvae (the immature stage) feed on the inner bark tissues disrupting the tree's ability to transport water and nutrients. EAB initially causes dying limbs or branches to appear in the upper crown, with symptoms progressively worsening to entire tree mortality, often in as little as 1-3 years (McCullough and Roberts 2002). The beetle is so named for the shiny, metallic-green coloration of the adult, which is rarely observed except in very heavy infestations (Figure 2).

Figure 2. Adult emerald ash borer (dorsal view) by Steve Valley.

The biology and ecology of EAB has allowed it to be very successful in infesting susceptible ash species and cultivars in North America, and although surveys, examining pathways of movement, and regulatory action have increased greatly each year since its introduction, the rapid spread that continues to occur to both new and

within infested areas suggest that its movement to Western states may occur and as such this beetle poses a significant ecological and economic threat to Oregon.

Spread Potential to Oregon: HIGH

The high fecundity, adaptable life-cycle, and cold hardiness of EAB all contribute to its high spread potential (Dobesberger 2002). Females may mate several times and lay 60-90 eggs throughout their lifetime (McCullough and Katovich 2004). Life stages are able to survive for long periods of time within the host tissues (Xiao 1991), taking up to 2-3 years to complete development in colder climates, and increasing its risk of being moved to new areas (CABI 2004).

There is a high risk that EAB could be transported to Oregon, as it has been moved unintentionally through many common pathways including nursery stock, firewood, logs, and wood packing materials (Liu et al. 2003; CABI 2004; Haack and Petrice 2004). Although infestations have led to greater regulatory action by the USDA and other agencies, enforcement has been extremely difficult.

Firewood appears to be one of the primary means by which EAB has been introduced to new areas (Haack and Petrice 2004), and represents a threat for importation to Oregon as well. The recreational opportunities in our state draw people from across North America, and recent studies of campers visiting state parks in the Midwest indicate that up to 60% may bring their own firewood (Selness and Venette 2006). Even obtaining firewood from more "local" sources within Oregon may represent a risk as recent studies indicate it may be obtained from sources outside the state and has been found to contain live, wood-boring insects.

Also, as it appears EAB was likely introduced originally to Michigan from solid wood packing materials transported from Asia, the high volume of international shipments that are currently received and processed at ports throughout Oregon pose a risk of introduction of EAB by that pathway as well.

Establishment Potential in Oregon: HIGH

If EAB does arrive in Oregon, there appears to be a high probability that it would become established. While Oregon ash (*Fraxinus latifolia*), which naturally occurs at low densities across much of the western part of the state, is the only native true ash, a number of other ash species and cultivars are planted ornamentally across the state (Jensen and Ross 2005), and all would appear to be susceptible to EAB (Haack et al. 2002; Liu et al. 2003). The "mountain-ash" (*Sorbus* spp.), which is found at higher elevations in Oregon, is not a true ash and does not serve as a host.

In China, EAB is found primarily in *Fraxinus chinensis* and *F. rhynchophylla* forests, although there are a number of other reported hosts in Asia (Table 1). In North America, EAB has shown the ability to infest native green ash (*F. pennsylvanica*), white ash (*F.americana*), and black ash (*F. nigra*), and several horticultural varieties, as well as to feed on other members of the ash family including forsythia, fringe tree, lilac, and privet (Haack et al. 2002). Unlike most wood-boring beetles in this family, they not only attack

weakened and stressed trees, but routinely kill healthy, vigorous ash hosts (McCullough and Roberts 2002).

Table 1. EAB Host Plants

Fraxinus spp. (Yu 1992)
Fraxinus chinensis subsp. chinensis (Yu 1992)
Fraxinus chinensis sbsp. ryhchophylla (Yu 1992)
Fraxinus pennsylvanica (Liu et al. 2003)
Fraxinus americana (Liu et al. 2003)
Fraxinus nigra (Liu et al. 2003)
Fraxinus quadrangulata (Liu et al. 2003)
Fraxinus mandshurica (Liu et al. 2003)
Fraxinus velutina (Liu et al. 2003)
Fraxinus mandshurica var. japonica (Liu et al. 2003)
Juglans mandshurica var. sieboldiana (Haack et al. 2002; Liu et al. 2003)
Julglans mandshurica var. sachalinensis (Haack et al. 2002; Liu et al. 2003)
Pterocarya rhoifolia (Haack et al. 2002; Liu et al. 2003)
Ulmus davidianan var. japonica (Haack et al. 2002; Liu et al. 2003)

In regard to climate and habitat suitability, EAB will likely be very successful in Oregon (Figure 3). It is native throughout the Palearctic and Indo-Malayan regions of northeastern Asia, and has readily established itself in Nearctic regions of central and eastern North America. The historical distribution of EAB is most closely associated with temperate broadleaf and mixed forests. Characteristic broadleaf trees in this biome include oaks (*Quercus* spp.), maples (*Acer* spp.), and birches (*Betula* spp.), and where conifers are included, pines (*Pinus* spp.), firs (*Abies* spp.), and spruces (*Picea* spp.) (Olson et al. 2001). Temperate broadleaf and mixed forests occur in relatively warm and rainy climates, often having a distinct dry season. The forests of the Willamette Valley in western Oregon are included in this designation and thus would be highly favorable to EAB.

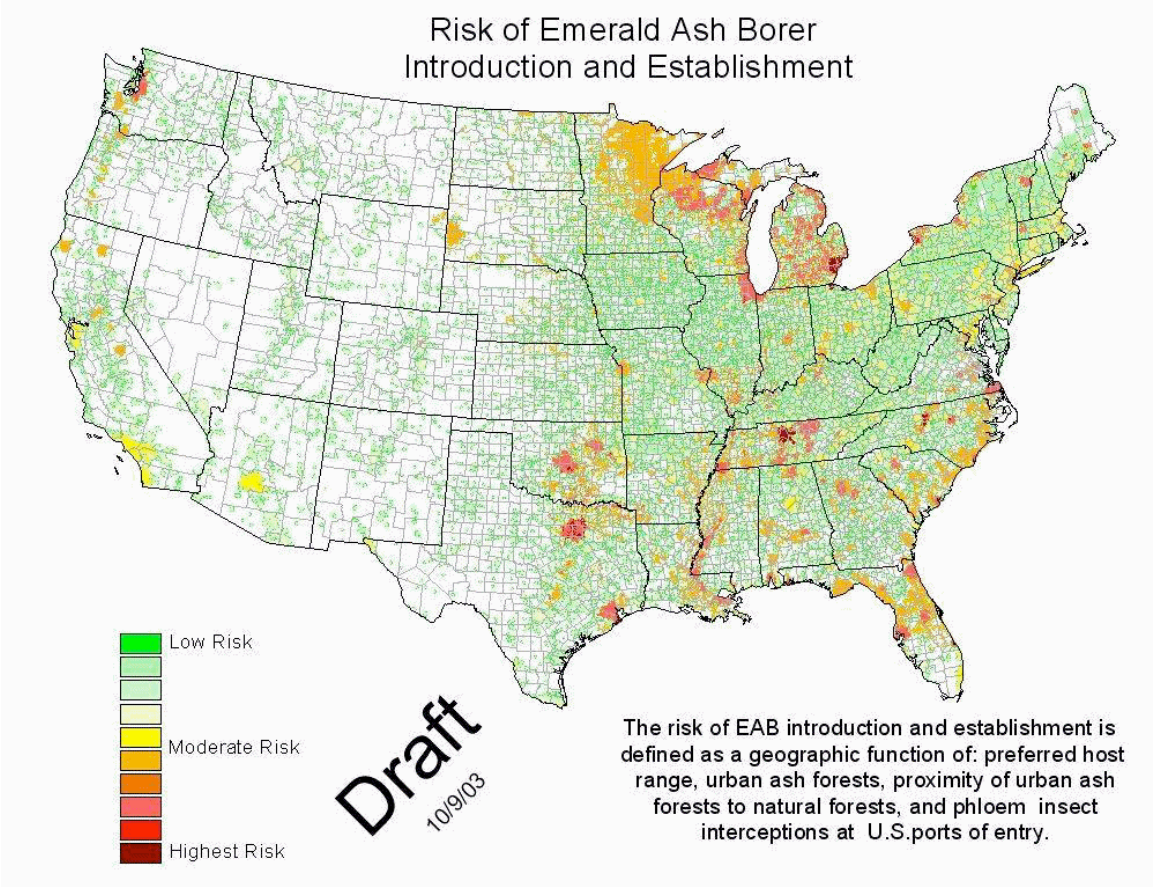

Figure 3. Risk of EAB introduction and establishment. USDA FS FHTET 2005.

In addition to the susceptible species found in natural and urban settings, nursery plantations in Oregon containing ash species would also be suitable for EAB survival and spread (Dobesberger 2002). The ability of the adults to fly distances up to several kilometers, would also allow EAB to utilize the abundant forest corridors that occur in Oregon, further increasing its dispersal and risk of establishment.

Environmental Impacts to Oregon: HIGH

Emerald ash borer decimated ash forest in Michigan during July of 2006. Photo by Josh Vlach.

In North America, the absence of specialized natural enemies of EAB coupled with the lack of host resistance has contributed to large outbreaks that have caused substantial tree mortality over large areas. In Michigan alone, millions of ash trees have been killed since the first detection in 2002 (Haack et al. 2002; Liu et al. 2003). While the abundance of ash in natural forests of western Oregon does appear to be substantially less than in the Midwest, ash remains an important component in these settings, contributing to riparian health and wildlife habitats. It is well adapted to the high moisture of stream banks, sloughs and lowland areas, thriving in western Oregon's bottomlands that drain poorly and may remain wet for months (Jensen and Ross 2005).

EAB could permanently alter the plant composition of these important riparian habitats. Substantial ash mortality in these areas may not only affect water resources and forage for wildlife, but can also increase the risk of fire in some areas or facilitate the invasion and establishment of non-native plants (Puric-Mladenovic et al. 2000).

EAB damage to a particular area depends largely on the coverage and composition of ash species, relative tree age and health, as well as temperature and other environmental factors (Yiguo 1966; MacFarlane and Meyer 2005). In China, relatively small outbreaks of EAB occur in exposed forest stands that are >7 years old. The most susceptible trees are generally those that occur in open areas or along forest edges. While severe infestations in China may lead to some tree mortality, damage tends to be

short-lived and localized due to the mitigating effects of natural enemies and host plant resistance (Liu et al. 2004; Gould et al. 2005).

Economic Impacts to Oregon: HIGH

Killed landscape ash trees in Michigan during July of 2006. Photo by Josh Vlach.

The potential economic impact of EAB could prove to be high, as it has the potential to greatly affect native and ornamental ash in Oregon costing municipalities, property owners, nursery operators, and forest products industries millions of dollars.

EAB has the ability to rapidly infest and kill trees of various size and condition; from small nursery stock (<5 cm in diameter) to large mature, street trees (Haack, 2002). The potential impact of EAB to urban environments nationwide has been estimated at a 1-2 percent loss of the total leaf area (30-90 million trees) valued at $20-60 billion dollars nationwide (McPartlan et al. 2004).

The disposal and replacement of trees in urban settings can be extremely expensive on a large scale. Ash accounts for as much as 20-40 percent of the street trees found throughout the Midwest (Haack et al. 2002), and has led to significant cost increases to the municipalities who maintain them. While Oregon appears to have a much lower percentage of ash in these settings by comparison, native species and their cultivars are highly preferred ornamentals around the state (ODF Urban/Comm. Forestry, pers. comm). The direct and intangible costs associated with the loss of these trees are

substantial, included reduced energy conservation, noise buffering, and aesthetic value (Kenney and Idziak 2000).

The economic impact to the nursery industry in Oregon may also be substantial. Oregon's nursery and greenhouse industry valued at over $988 million dollars for 2007 (Oregon Dept. of Agriculture 2008). If EAB were to arrive and become establish in Oregon, regulatory actions in the form of quarantines or restricted trade, as have occurred recently in other affected areas, could significantly reduce Oregon's substantial exports of woody ornamentals.

Ash is not a significant component of the wood products industry in Oregon, although it does have some specialty uses due to the strength and attractiveness of the wood (Jensen and Ross 2005).

Health Impacts to Oregon Residents: LOW

EAB is not known to cause any adverse impacts to human health.

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Format:

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