Cold snap is no snow day for emerald ash borer management

"Biological and Environmental Influences on Forest Health and Productivity"

A research work unit of the USDA Forest Service Northern Research Station

359 Main Road Delaware, OH 43015

For more information, contact [Robert C. Venette]

Principal Partners:
Rob Venette, US Forest Service Northern Research Station;
Lindsey Christianson, University of Minnesota Dept. of Entomology;
Mark Abrahamson, Minnesota Department of Agriculture, Plant Protection Unit

January 31, 2014

Summary

Emerald ash borer (EAB) causes problems when it becomes very abundant in an area. Populations grow slowly until they reach a "tipping point" after which they can grow very rapidly – killing many trees in a short time (1-3 years).

We have found that some EAB larvae begin to freeze and die when temperatures within trees reach -20°F and that survival is very unlikely when temperatures reach below –30°F.

In areas where the coldest winter temperature is generally warmer than -20°F, cold mortality is unlikely to have much or any impact on the population increase of EAB.

In areas where the coldest winter temperature is generally between -20°F and -30°F, cold mortality may delay the increase of EAB to levels that kill trees, but EAB should still be expected to reach tree-killing levels.

In areas where the coldest winter temperature is generally colder than -30°F, cold mortality may have a major impact on population increase of EAB – perhaps to the point of constraining populations below tree-killing levels. We cannot confirm this right now, but we are working to answer this question.

We speculate that temperatures within known EAB-infested areas in Minnesota have been cold enough in recent weeks to cause a moderate to high level of larval mortality. This winter mortality should slow EAB population growth in these areas but it is probably not enough to justify changing management plans. EAB populations will likely recover and should still be expected to grow to tree-killing levels.

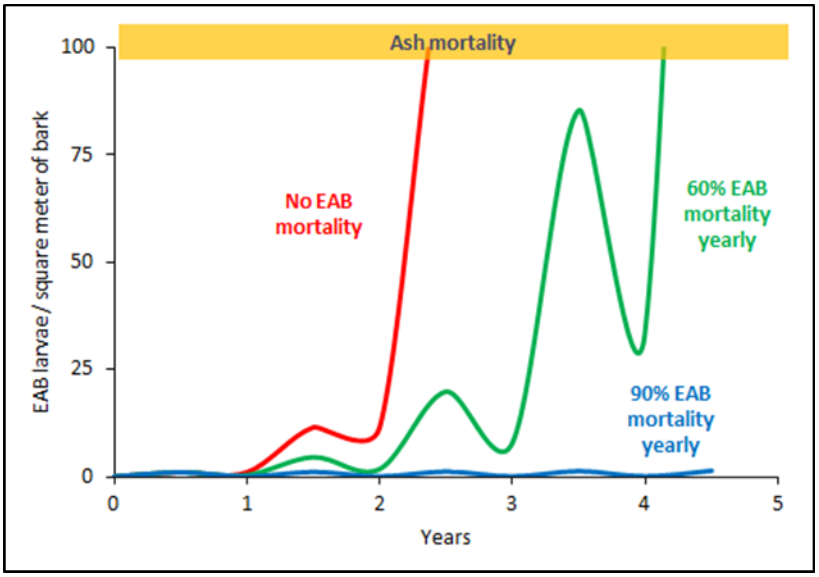
Cold snap is no snow day for emerald ash borer management

"Biological and Environmental Influences on Forest Health and Productivity"

A research work unit of the USDA Forest Service Northern Research Station

359 Main Road
Delaware, OH
43015

Mortality of EAB due to cold



This is a hypothetical example of EAB population increase to illustrate the possible effects of yearly 60% mortality and 90% mortality.

Recent media reports have described the potential impact of extreme cold weather on emerald ash borer. Data collected by us from the winters of 2009-2012 indicate that a substantial fraction of emerald ash borer larvae may die as temperatures within trees fall below -20° F. At that temperature, mortality should be about 50%. Mortality rates increase quickly to about 90% as temperatures approach -30°F. **Wind chill does not affect EAB**. Recent cold temperatures were unlikely to eliminate emerald ash borer populations. In most cases, the cold has simply set the populations back. Without additional, severe periods of cold, emerald ash borer populations would be expected to rebound to current densities in a generation or less (<1 to 2 years); however, this brief population setback provides additional time for communities to develop or implement plans for ash borer management.

For more information, contact Robert C. Venette

Cold snap is no snow day for emerald ash borer management

"Biological and Environmental Influences on Forest Health and Productivity"

A research work unit of the USDA Forest Service Northern Research Station

359 Main Road Delaware, OH 43015

EAB is a problem because of their potential for rapid population growth and resulting tree mortality. When EAB invades an area there is a characteristic lag period where populations are too small to kill trees and typically too small to detect. However, EAB populations eventually grow to a "tipping point" where population growth accelerates and tree mortality occurs rapidly. Winter mortality of larvae would help to slow population growth and consequently the rate of tree mortality. However, unless winter mortality is consistently very high, EAB populations should still be expected to reach tree-killing levels, albeit more slowly than in areas where no winter mortality occurs.

For these reasons, the authors are not advising any short-term changes to the implementation of municipal or state plans to manage emerald ash borer. Forecasts of emerald ash borer mortality need to be confirmed with independent observations. These observations will be collected during the remainder of the 2013-2014 winter and in the spring/summer of 2014. The Minnesota Department of Agriculture, US Forest Service, and University of Minnesota have established a network of field plots in natural and urban settings. Plots occur in Duluth, the Twin Cities, and several locations in southeastern Minnesota. Branch- and whole-tree samples will be collected this winter, bark removed, and the density of condition of emerald ash borer larvae noted. Larvae injured by cold will be discolored (e.g., black or dark-brown vs normal cream color) or remain inactive once removed from a tree.

Management plans for emerald ash borer should be responsive to winter kill, but periods of extreme cold do not justify inaction. Plans devoted to the diversification of forests away from ash, regardless of emerald ash borer densities, would be unaffected by winter temperatures. Assessments of the composition and condition of forests are vital to emerald ash borer management and should proceed. Management goals should be clearly articulated; and tools and strategies selected to meet those goals. Different strategies may be appropriate in areas with different winter low temperatures.

For more information, contact [Robert C. Venette]

Cold snap is no snow day for emerald ash borer management

"Biological and Environmental Influences on Forest Health and Productivity"

A research work unit of the USDA Forest Service Northern Research Station

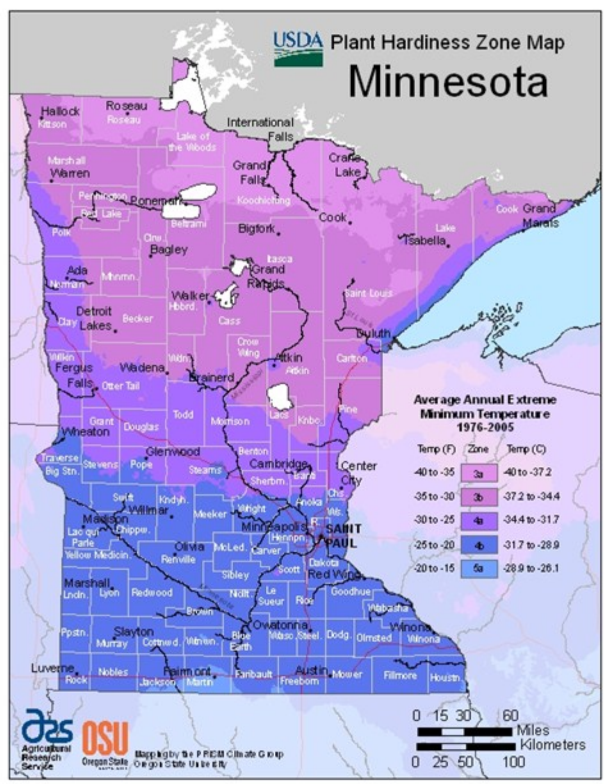
359 Main Road
Delaware, OH
43015

For more information, contact [Robert C. Venette]

The Forest Service and the Minnesota Department of Agriculture are still exploring options to incorporate cold mortality into emerald ash borer management plans. Here are some options to consider for different parts of the state:

(USDA Plant Hardiness Zones 3a and 3b; annual low temperature < -30°F). Winter mortality of emerald ash borer could be high in most years. Communities are encouraged to conduct tree inventories and general surveillance for signs of emerald ash borer. If evidence suggests emerald ash borer is present, branch samples could be collected to assess the extent of infestation and condition of larvae. Regular surveys for infested trees and rapid removals of infested trees may be sufficient to prevent outbreaks.

(USDA Plant Hardiness Zones 4a and 4b; annual low temperature between -20 to -30°F). Winter mortality is likely to be variable from year to year. Communities are encouraged to conduct tree inventories and develop ash borer management plans. General surveillance for emerald ash borer should include visual inspections of trees. Integrated Pest Management plans are encouraged. Poor quality ash trees should be removed.



Cold snap is no snow day for emerald ash borer management

Trees with evidence of emerald ash borer should be promptly removed and destroyed or treated with insecticide. Years with extreme cold may extend re-treatment intervals.

(USDA Plant Hardiness Zones 5a; annual low temperature >-20° F). Winter mortality of emerald ash borer is expected to be light in most years. Surveillance with tree inspections are appropriate and should be intensive if the management goal is to preserve mature ash trees as long as possible. Communities should be prepared to respond quickly and aggressively upon detection of emerald ash borer. Diversification of forests away from ash is appropriate.

The bark does offer some insulation to the larva from nightly low temperatures. When these lows occur, temperatures beneath the bark are typically about 1°C (about 2°F) warmer than nearby air temperatures. However, the location of the tree (e.g., proximity to buildings, southern exposure, and density of neighboring trees) can affect low temperatures that a tree might experience.

Other facts about EAB and the winter

Overwintering biology. Emerald ash borer spend the winter as larvae beneath the bark of ash trees. If the preceding growing season was sufficiently long and warm and the host was appropriate, the larvae are most likely to be fourth instars inside pupal cells. The pupal cell is a chamber created by a larva in the outer wood of the tree where pupation will occur. Larvae in these cells are frequently said to be in a J-stage given their appearance as they fold in on themselves. If the growing season was not sufficient or the host slowed development of the insect, larvae are likely to be first (rare) to fourth instars just beneath the bark and not inside a pupal cell.

"Biological and Environmental Influences on Forest Health and Productivity"

A research work unit of the USDA Forest Service Northern Research Station

359 Main Road Delaware, OH 43015

For more information, contact [Robert C. Venette]

Cold snap is no snow day for emerald ash borer management

Forecasts of winter mortality. The extent of winter mortality depends on the condition of emerald ash borer larvae and the severity of cold experienced during the winter. (Ongoing research is attempting to assess whether the duration of cold may also affect mortality). The cold tolerance of emerald ash borer varies seasonally between a summer condition and a winter condition. The transition to the winter condition typically begins in mid-late October, and the transition to the summer condition begins in February-March. Cold tolerance also varies annually and with the host. The extent of cold tolerance may depend on concentrations of cryoprotectants (especially glycerol) that larvae can produce. These cryoprotectants keep the larva from freezing, but once freezing occurs, the larva dies.

The bark does offer some insulation to the larva from nightly low temperatures. When these lows occur, temperatures beneath the bark are typically about 1°C (about 2°F) warmer than nearby air temperatures. However, the location of the tree (e.g., proximity to buildings, southern exposure, and density of neighboring trees) can affect low temperatures that a tree might experience.

"Biological and Environmental Influences on Forest Health and Productivity"

A research work unit of the USDA Forest Service Northern Research Station

359 Main Road Delaware, OH 43015

For more information, contact [Robert C. Venette]