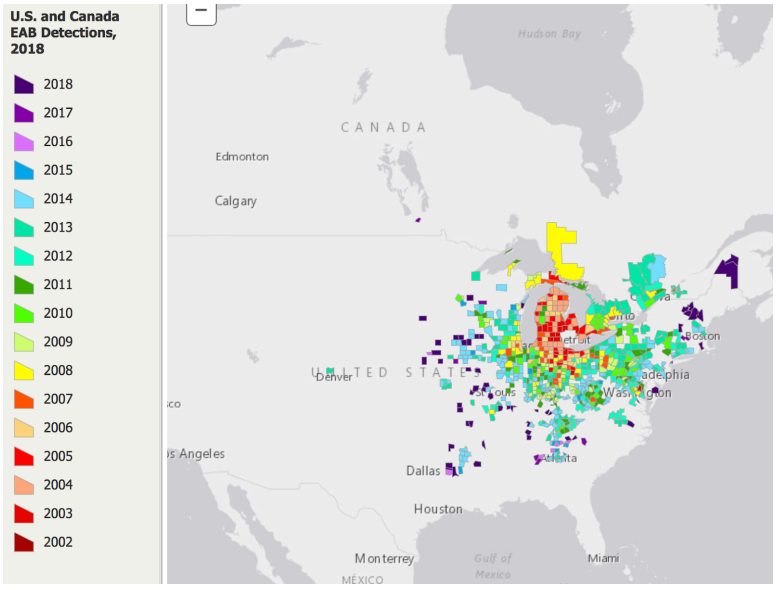
Emerald Ash Borer
Four phases of spread of a nonnative forest pest

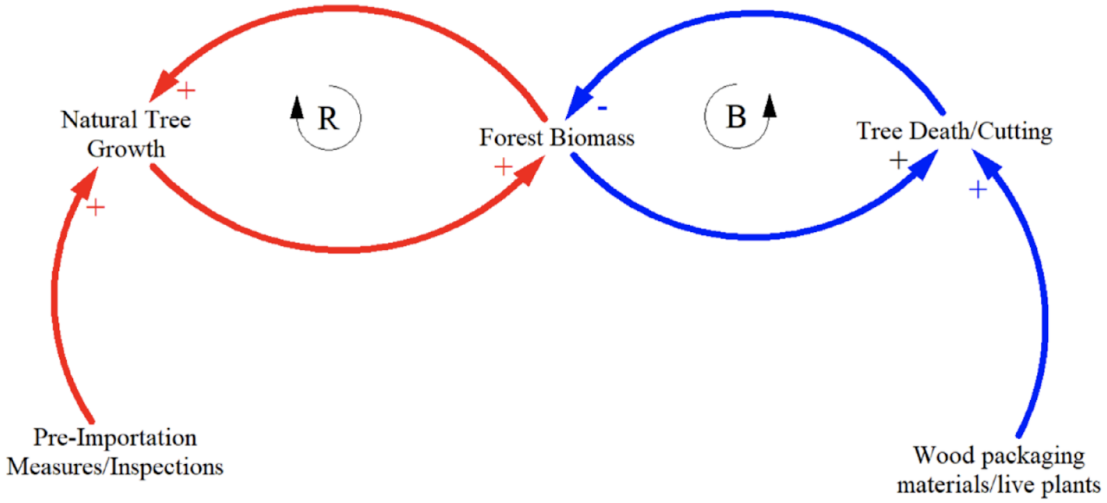
Emerald Ash Borer - Four phases of spread

This essay will review the effectiveness and cost of policies designed to reduce the impact of non-native forest pest infestations by discussing the case of the Emerald Ash Borer *Agrilus planipennis (*Fairemaire) (EAB) in each of the four phases of spread: absent, localized, spreading and pervasive. EAB is an invasive insect species from Asia that was first observed in the greater Detroit Metropolitan Area in 2001 (Hair 2001**).** It is believed to have arrived in North America through wood packaging materials associated with imported goods from Asia, though there is no certainty as to precisely when or how it arrived. While little seems to have been known about this insect at the time of discovery, a great deal of research has been conducted and extensive policies have been initiated to limit the spread of EAB due to its devastating impact on North American ash tree species. Already, millions of trees have been destroyed and EAB threatens to kill most of the billions of ash trees in North America. The destruction of trees along with the policies instituted to limit its spread and manage infestations have made EAB one of the most destructive and costly invasive forest species ever.(Aukema et al., 2011) (Kovacs et al., 2010). Now that EAB has a substantial presence in North America, the two primary pathways for its spread are natural



Emerald Ash Borer Detection map by county and year.
Emerald Ash Borer Information Network

migration and human-assisted spread, with the transport of firewood being one of the key pathways (APHIS 2011). The ecological and economic implications of the spread of EAB are enormous. The economic damage to landscape trees alone is forecasted to be over $12.5 billion (Kovacs et al., 2011). The ecological damage can include a significant shift in the nutrient profile of soils and major impacts on a variety of insect, plant and other wildlife species that feed on ash trees. (Valenta et al., 2016).

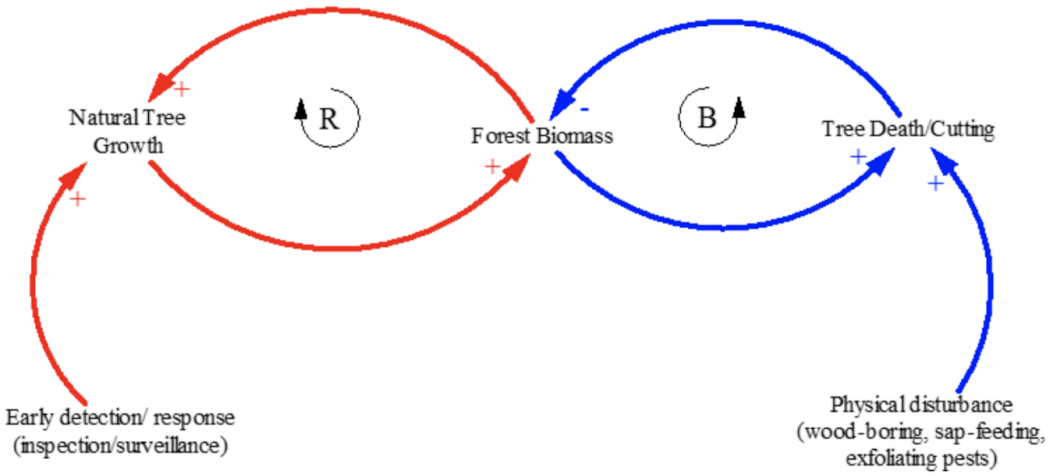


Absent Phase

In the absent phase of the spread of a nonnative forest pest like EAB, inspections, quarantines and pre-importation treatment of firewood and live plants are policy tools that enhance the reenforcing loop supporting natural tree growth and increase forest biomass. By reducing or eliminating the importation of infested wood packaging materials and live plants, the balancing loop dynamic infestation creates by increasing tree deaths and tree removals can be dampened. The international movement of wood and live plants has been identified as the

primary pathways for forest pests like EAB which makes Federal import restrictions critical to stemming the tide (Liebhold et al., 2012). The USDA requires permits for the importation of all unmanufactured wood products into the United States, and heat treatment or fumigation of all wood packaging materials except those from Canada (APHIS 2015). Firewood imported from other countries must undergo heat treatment of 71 degrees celsius for 75 minutes prior to entrance into the United States (APHIS 2011). However, even a casual review of the literature gives an indication of the complexity and difficulty of managing policies designed to prevent the arrival of EAB due to the sheer scale of global trade.

The costs associated with protective measures enacted in the absent phase of infestation occur primarily at the Federal level. The 2018 USDA budget contemplates a $30 million expenditure on tree and wood pests, down from $54 million in 2016 and 2017 (USDA 2018).



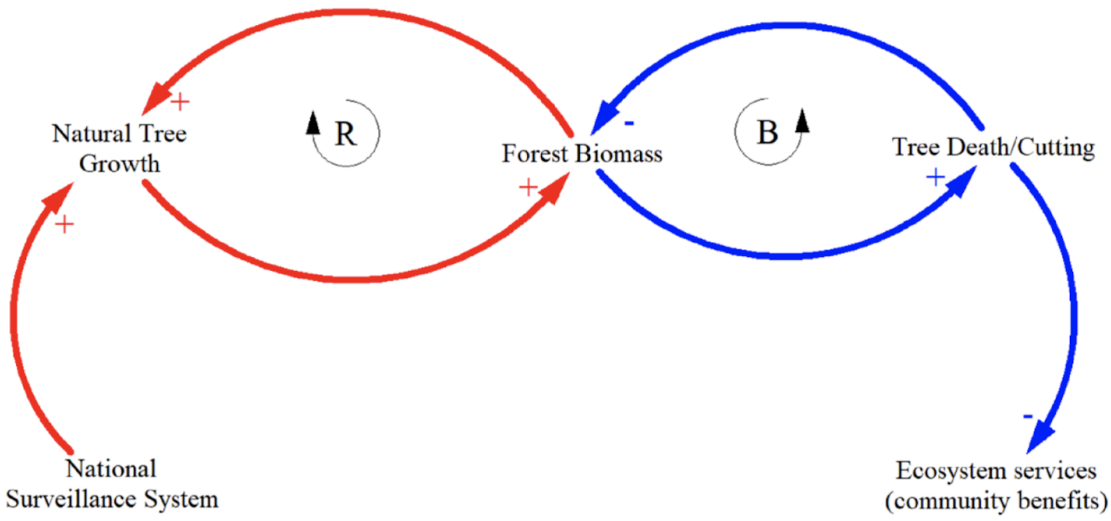
Localized Phase

In the localized phase of spread, early detection and response programs can positively impact forest biomass through the reenforcing loop with post entry quarantine and surveillance programs. These programs help to slow or prevent the further spread of EAB to uninfected areas, and create opportunities for proactive policies to remediate or selectively treat trees. Surveillance at high-risk sites have been cited as expensive though effective with a substantial positive economic impact (Epanchin-Niell et al., 2012). One of the most effective surveillance initiatives is ash tree girdling whereby bark is stripped off a section of an ash tree to attract female egg laying EAB. This is an effective early warning strategy in urban areas though it is not applicable in the forest setting. (McCullough et al., 2011)

Given the virulent nature of EAB, some communities with a substantial number of Ash trees have also preemptively prepared readiness plans and instituted a number of strategies to quickly identify and manage any EAB infestations. Those strategies include municipal tree inventories, the establishment of detection trees as mentioned above, the installation of traps, removal of suspect or infested trees and selective applications of insecticides (City of Crystal Lake 2008).

These strategies come, however, at a substantial costs, with the majority of the burden falling on homeowners and local governments in this phase of spread. Tree removal, protection through selective application of insecticides and replacement of lost trees are estimated to exceed $1 billion per year in urban areas alone (Kovacs et al., 2010). The impact of localized phase containment strategies are put into perspective when reviewing photographs of once beautiful tree lined streets after wholesale tree removal has occurred due to EAB infestation. Documentary

interviews of families affected by tree removals begins to give one a sense of the generational economic and environmental costs to families.

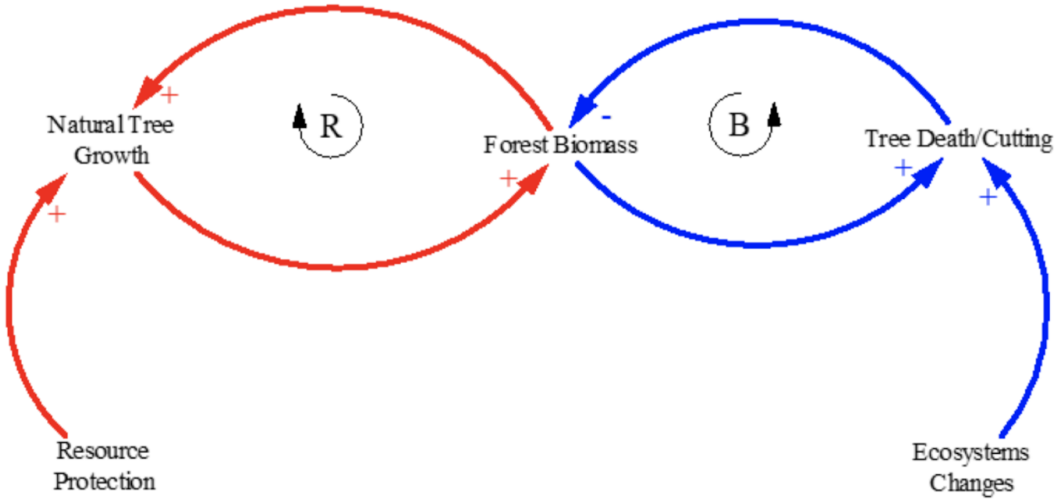


Spreading Phase

With EAB already established in many parts of the United States, policy measures in the spreading phase of infestation that have been most effective in reducing impact are Federal and state level quarantines on the transport of firewood. These programs strengthen the reenforcing loop dynamic and have a positive effect on forest biomass by restricting the human movement and subsequent spread of EAB. The balancing loop dynamic implies increasingly negative effects on communities as nurseries and firewood distribution companies face increasing costs and more restrictions on business activities. Federal regulations focus heavily on limiting the domestic transport of firewood in several states with active EAB infestations to prevent the spread to unaffected areas (APHIS 2011). Recent research highlights the critical role that effective firewood quarantines play in disrupting pathways that introduce EAB where it is

absent. In fact, the natural spreading of EAB is slow compared to the effects humans have when transporting infested firewood (BenDor et al., 2018). And with all ash logs and firewood exported from EAB quarantine areas being required to undergo chemical and heat treatment, substantial costs are borne by firewood distribution companies (Myers et al., 2009).

Even with these policies in place, the natural spread of EAB through insect flight appears to be inevitable. This continued spread is reflected in the balancing loop in the spreading phase as the community benefits of shade, beauty, economic value, and environment are degraded. In addition to quarantines related to firewood, any regulated items such as nursery stock, green lumber or any other material of any kind sourced from ash trees are not allowed to be transported out of Federal quarantine zones without a Federal permit (APHIS 2015). The costs associated with managing and maintaining quarantines, permitting impact state and Federal agencies as well as local communities.



Pervasive Phase

In the pervasive phase of EAB infestation, resource protection and forest biomass can be enhanced and EAB infestation limited through the promise of biological control or "biocontrol." By shifting the predatory dynamic in the natural environment on a large scale, the balancing loop dynamic related to tree deaths can be slowed and forest biomass positively impacted. Biocontrol is defined as controlling a pest by introducing a natural enemy or predator. Several natural predators of EAB have been investigated for their potential to manage EAB infestations and research is ongoing to introduce and monitor their effectiveness. According to the USDA, three species of insects from China that prey on EAB were introduced in 2007 and early results are encouraging. However, biocontrol programs are by their very nature longer term propositions so the USDA expects it to be many years before they know if biocontrol can provide effective protection to ash trees (USDA 2018).

Biocontrol is the only management option that is viable for large scale, or landscape level deployment with the objective of bringing the EAB population into a natural balance with

predators and hopefully preventing the annihilation of ash tress in North America. While specific budget figures for the USDA's EAB biocontrol program were not identified, the magnitude and impact of EAB infestations is so large at this point that biocontrol offers one of the best hopes to contain and manage the pest and save substantial numbers of ash trees.

Conclusion

EAB has moved swiftly through each of the four phases of spreading of nonnative forest pests since it was first detected in 2001. The threat this forest pest presents to virtually all of the 8 billion ash trees in North America makes EAB infestation management and containment critical. With the estimated cost of replacing ash trees in urban and residential settings alone approaching $25 billion, the $30 million spent annually at the Federal level to manage tree and wood pest populations seems to be a worthwhile investment. (Gould et al., 2014).

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