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Kickapoo Environmental Office

The Green Clan

Working Together for a Better Community!
ktik-nsn.gov/kickapooenvironmentalprotection.htm
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The Carbon Cycle – What goes 'round comes 'round

Carbon is a chemical element. It is part of all the Earth - oceans, air, rocks, soil and all living things. It is essential to life on Earth. All living things are made up of organic molecules which contain carbon, and they also use carbon as a source of energy.

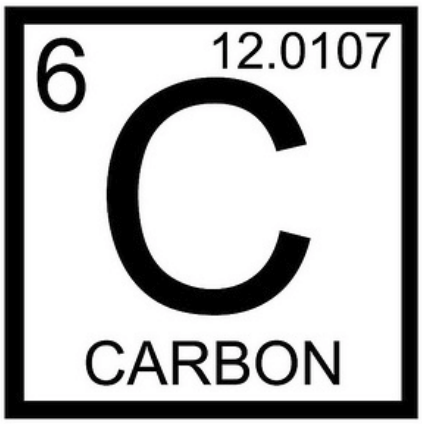
Carbon doesn't stay in one place. It is always moving through the Carbon Cycle. Most of the carbon in the air around us is attached to oxygen in a gas called carbon dioxide (CO2). With the help of the Sun, plants pull CO2 from the air to make plant food through the process of photosynthesis.

Carbon moves from plants to the animals that eat them, and it also moves from animals to other animals that eat them. It moves back to the air when animals use the carbon they eat for energy and breathe out CO2. It also moves from plants and animals to the soil when they die. If dead plants and animals become buried deep in the ground for a very long time, they become fossil fuels (like oil and coal).

Carbon dioxide also dissolves directly from the atmosphere into bodies of water (oceans, lakes, etc.), as well as dissolving in raindrops when they fall through the atmosphere. Carbon dioxide reacts with water molecules and forms carbonic acid, which contributes to ocean acidity.

Human activity over the past two centuries - during the industrial revolution - has significantly increased the amount of carbon in the atmosphere, mainly in the form of CO2. This has been done by emitting it directly into the air, mostly by burning fossil fuels and manufacturing concrete. Most of the carbon in the Earth's coal and oil reserves was stored there over the last 400 million years, and much of it has been released as CO2 in the last 150 years. Through deforestation, urban development and some forms of agriculture, humans have also reduced nature's ability to extract CO2 from the atmosphere.

In the air, CO2 is a greenhouse gas which traps heat in the atmosphere. Without it and other greenhouse gases, Earth would be a frozen world. Humans, however, have burned so much fossil fuel that there is about 30% more CO2 in the air today than there was 150 years ago. It's estimated from measurements in glacial ice that there has not been this much carbon in the air for at least 420,000 years. This additional CO2 in our atmosphere is causing our planet to become warmer.



Higher temperatures increase decomposition rates in soil, thus returning carbon stored in dead plants and animals to the atmosphere more quickly. Current trends in climate change have also led to higher ocean temperatures, further affecting nature's balance. Acid rain and polluted runoff from agriculture and industry are also changing the ocean's chemical composition. These changes have dramatic effects on sensitive ecosystems such as coral reefs, thus reducing the ocean's ability to absorb carbon from the atmosphere on a regional scale and reducing oceanic biodiversity.

The Kickapoo Nation has already experienced recent extremes in weather indicative of changing climate. These events (drought, flooding, record high and low temperatures, etc.) will continue to put increasing demands on our resources. Two things are certain:
1) our climate will continue to change; and
2) Native America will remain resilient and continue to adapt.

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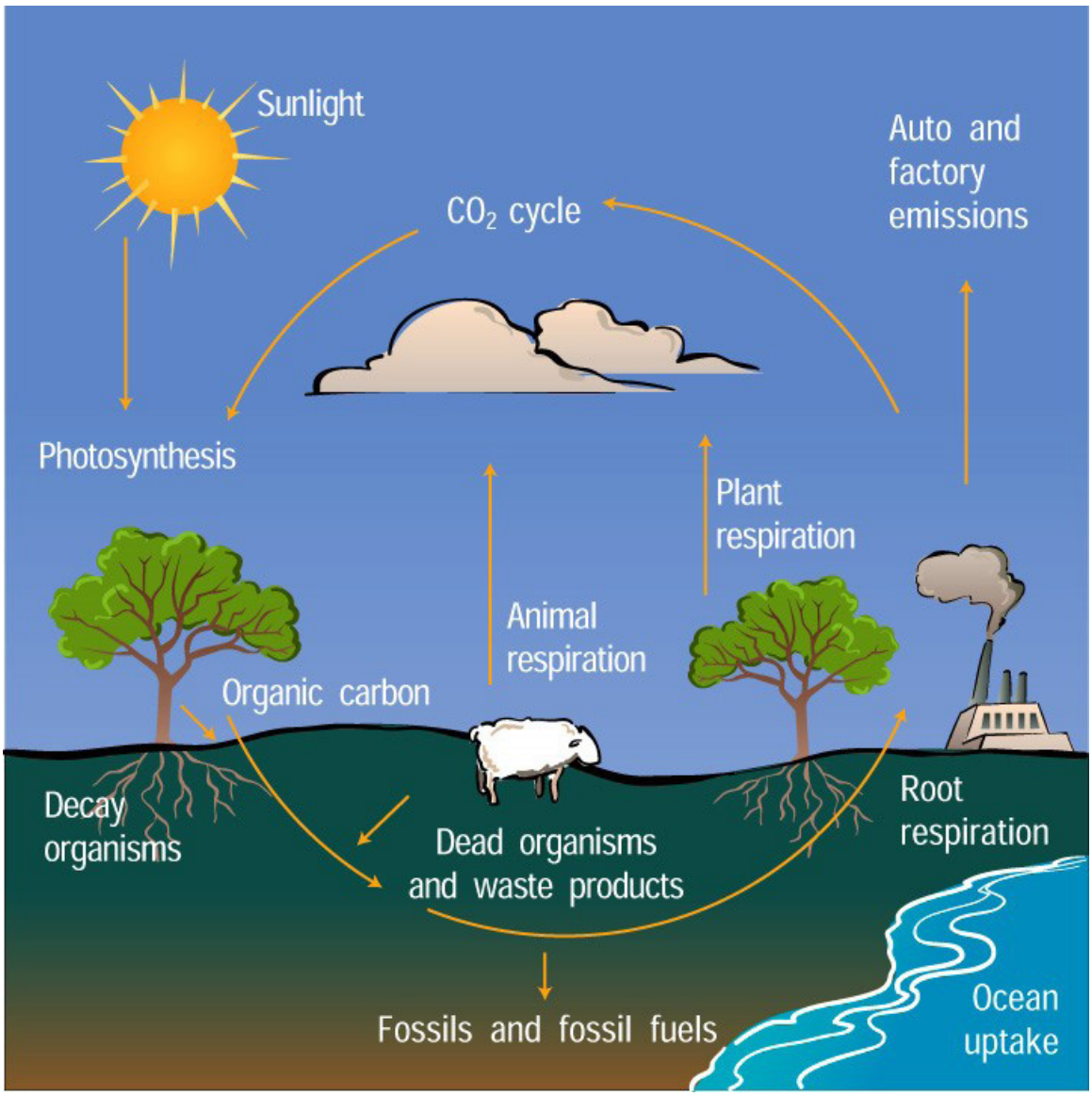

Burn It Where You Buy It

Since the first documented sighting in the United States in 2002, the emerald ash borer (commonly known as EAB)has decimated Ash tree populations across the Midwest, costing the US economy over $10 billion dollars in the last 12 years (Kovacs et al., 2010). EAB (Agrilus planipennis) was initially discovered in Detroit, Michigan, and likely made its unpopular debut into the United States by hitch-hiking in packaging material made from infested ash trees. The insect is currently present in over 20 states, and continues to spread, adding approximately 25 miles a year to its range (Image 1).

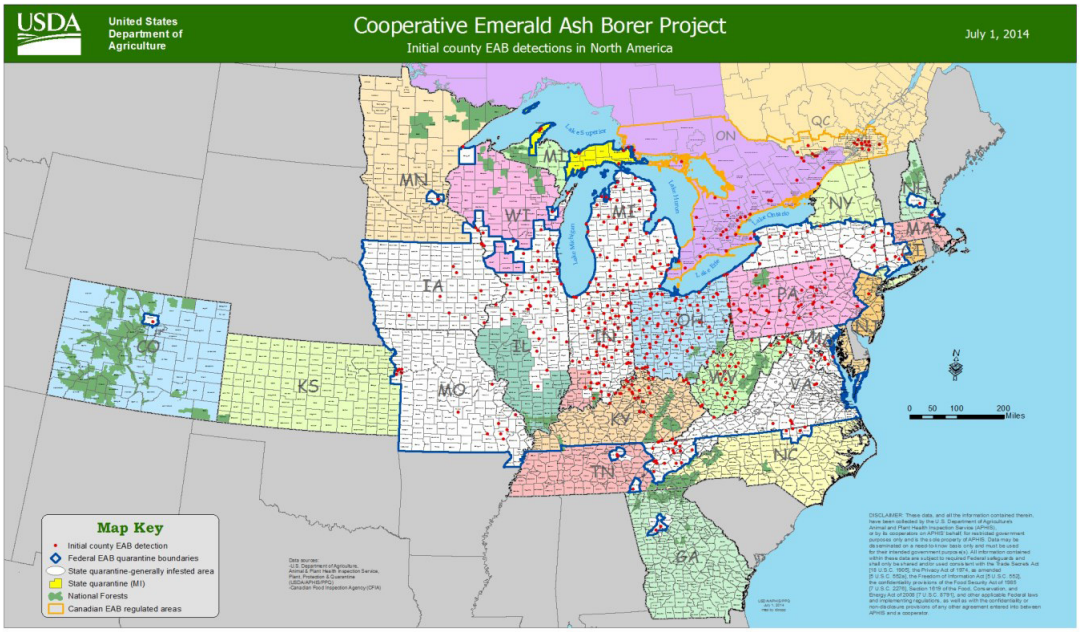

Image 1. Current US infestation map since its original discovery in Michigan and Ontario (2002). Red dots indicate infested areas, blue borders indicate quarantine boundaries. (USDA 2014)

While this is not the first time the US has seen an exotic spe-cies cause significant decline in tree species, it has however become the most destructive insect to ever invade the urban, suburban, and rural forest populations. The purpose of this article is to: (1) shed some light on how this insect will affect our ash tree population in Kansas; (2) give the reader tools necessary for identifying EAB and vulnerable tree stands; (3) and introduce ways to combat the infiltration of this damaging, yet vibrant insect.

The Kansas Department of Agriculture (KDA) recovered the first adult specimen in Wyandotte County, KS on Au-gust 29th, 2012 from a survey trap (Image 2). The beetles have now been observed in Wyandotte (August, 2012), Johnson (July, 2013), and Leavenworth (July, 2014) counties, and quarantines are in place to slow the invasion. Studies indicate Borers are attracted to ash trees through chemicals produced by the trees and can locate the trunks by sight (McCullough, 2013). Survey traps are designed to mimic the silhouette of an attractive tree trunk and are positioned to attempt early detection in vulnerable stands. Superficial indicators of an EAB infested stand include thinning of canopy growth and the presence

of small shoots growing from the base of the trunk (Image 3). Further indications of EAB predation are found by examining the tissue layer under the bark (phloem) for S-shaped larval galleries and D-shaped exit holes (Image 4). Unfortunately, the success of survey methods for detecting beetle populations are limited, and areas showing evidence of the beetle will likely be decimated in 3-5 years. Once stressed, a tree is more susceptible to pathogens, drought, and insect predation, however, despite the bleak fate for our beloved ash trees in Kansas, there are a few methods for staving the progression of the emerald army.

Image 2. Survey trap installed by the USDA to monitor for the presence of EAB on the Kickapoo Reservation.

The most successful method for delaying mortality of an ash tree comes in the form of systemic pesticide injections; however, it is very costly (Image 5). These pesticides are absorbed like a sponge by the phloem, and transported throughout the tree. Since the larvae feed on the phloem, many of the larvae die. Unfortunately, some will persist, continue damaging the phloem, and eventu-ally cause the tree to starve from loosing the ability to transport nutrients. Yearly treatments are necessary, and contacting an experienced commercial pesticide applicator will provide the most accurate treatment options.

Image 3. Stressed trees can display both thinned canopy foliage and small shoots. Stressed trees are more vulnerable to severe weather conditions and further insect predation.

Image 4. (Left) D-shaped exit holes made by adult Emerald Ash Borer. (Right) S-shaped galleries produced by EAB larvae eating phloem under the bark.

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Image 5. Pesticide injections are transported systemically by the phloem throughout the tree, targeting developing EAB larvae.

Adult borers are relatively easy to spot because of their metallic emerald green exoskeleton, however there are a number of insects commonly confused with the destructive borer. The image below (University of Minnesota) compares most misidentified insects to the actual EAB.

Early detection of an infestation is most effectively accomplished by locating stands of ash trees. All species of North American ash trees appear to be susceptible, and damage has been found in trees as small as 1" in diameter. The Nebraska Forest Service has come out with an excellent resource for identifying ash trees in your region.

The most widely used and cost effective tactic for preventing the spread of EAB is by not transporting untreated hardwood. The mantra, "Burn it where you buy it," is posted on signs and billboards throughout infected areas, and will likely gain prevalence in Kansas. Unarguably, this infestation has spread so efficiently during the last 12 years due to human assistance. As more trees succumb to EAB, the need to remove dead and dying trees for public safety and aesthetic reasons significantly increases. This wood is often taken away from urban and suburban neighborhoods and either dumped, or consumed as firewood in rural communities. Kansas Department of Agriculture has stated restrictions on removal of regulated articles from quarantined counties (Wyandotte, Johnson, Leavenworth) including removal of: emerald ash borer at any life stage; all hardwood firewood; ash chips and mulch; green lumber and any other material living, or dead, cut, or fallen, such as logs, stumps, roots, and branches of Fraxinus (ash); and Ash nursery stock. Additional information on compliance parameters involving the removal and transportation of ash across quarantined lines can be found at KDA's website by searching "EAB."

ASH TREE IDENTIFICATION

Across the U.S., ash trees (*fraxinus spp.*) are under attack by the emerald ash borer (EAB), an invasive insect that attacks and kills all native species of ash trees. The information below will help you properly identify ash trees.

Ash trees have an opposite branching pattern, meaning that branches are directly across from each other.

Ash seeds are paddle shaped and occur in clusters. Seeds will typically remain on trees until late fall or early winter.

Ash leaves are compound and typically consist of 5-11 leaflets. The edges of the leaflets may be smooth or toothed.

On mature ash trees, the bark has a distinct pattern of diamond-shaped ridges. Younger ash trees have smoother bark.

Background photo: Keith Kanoti, Maine Forest Service, Bugwood.org. Ash photos: Nebraska Forest Service.

Finally, research is being conducted into finding more permanent methods for combating this invasive species. Preliminary work has been performed using biological control methods including pathogenic fungus, genetically resistant trees, and parasitic wasps, however, since we are still on defense, preventative practices are the most effective means for hindering the movement of EAB. Like it or not, this insect, like many others, is here to stay. Since eradication is not possible we must continually modify our habits and practices to achieve harmonic coex-istence in the presence of invasive species.

Works Cited

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