2021 Forest Health Highlights

from the Kentucky Division of Forestry

Heavy ice accumulation on a maple branch after three consecutive winter storms in February 2021.

Kentucky is home to nearly 13 million acres of some of the nation's most diverse woodlands. Yet, this valuable resource is under attack. The most severe threats to our forests are insects, diseases, invasive plants, and bouts of extreme weather. This document touches on the most influential of these disturbances and provides an up-to-date review of their impacts within the Commonwealth over the past year.

Damages from this native forest pest, the oak lace bug, were widespread in regions of northern and central Kentucky this year.

EF4 tornado damage to forestland within Land Between the Lakes National Recreation Area.

EXOTIC INSECT PESTS

Emerald Ash Borer

Since its initial discovery within US borders in 2002, this exotic pest has continued to cover new ground throughout the country and can now be detected in 35 states (Figure 1). Naturally, this small beetle can only disperse a few miles per year on its own. Therefore, these expansions are often caused by human assists such as the movement of firewood or other infested material. This pattern is mirrored within the Commonwealth as this pest begins to pop up in western counties.

Infestations of the emerald ash borer (EAB) were first confirmed in Kentucky in 2009. A quarantine of 20 northern Kentucky counties, located in the region between Louisville and Lexington, was initially established. In the following years, additional EAB infestations were found in nearby counties and the state quarantine was expanded. In April of 2014, the county quarantine system ended and the entire state was added to the USDA APHIS list of regulated areas. This regulated region is historically the largest area in the nation that has been under Plant Protection and Quarantine. As such, APHIS proposed to remove the domestic quarantine and refocus their efforts on biological control of this exotic pest. This proposal was approved and took effect in January 2021.

EAB has been confirmed in 99 Kentucky counties to date (Figure 2). Ever since its arrival, EAB activity had led to mass mortality throughout our northeastern counties and decline continues to spread westward (Figure 3). In 2021, EAB was confirmed in three new counties: Hopkins, Warren, and Metcalfe, and will eventually impact ash resources across the entire state as the infestation continues to spread into western Kentucky. Infestations in neighboring states of Indiana, Illinois, Missouri, and Tennessee can only aid this expansion within the coming years.

The Kentucky Division of Forestry (KDF) will continue to monitor EAB's progress in 2022. As well as participating in biocontrol efforts for this forest pest by requesting EAB parasitoids from the USDA APHIS Release and Recovery Program.

Figure 1: 2021 EAB Map *red dots indicate infested counties and the blue line is the federal quarantine boundary

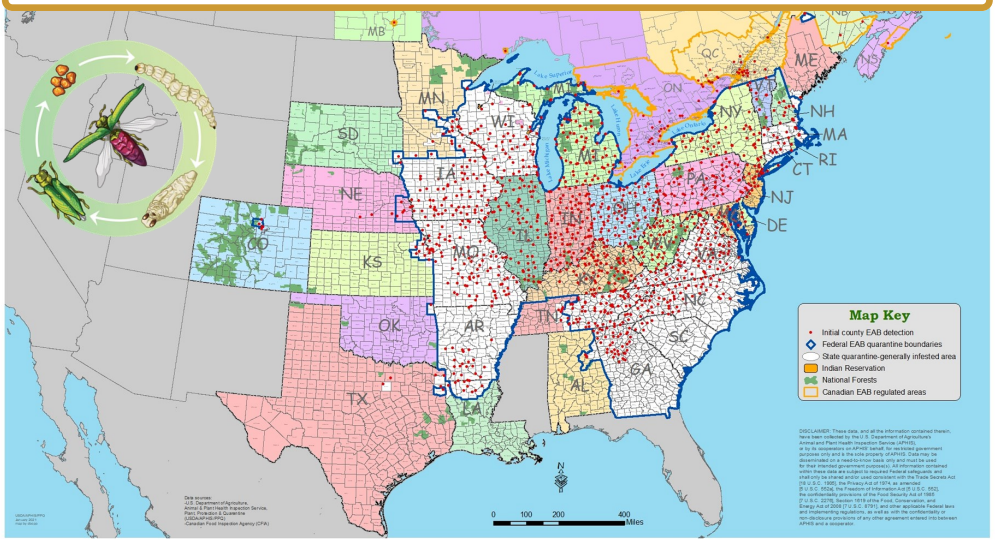


Figure 2: Kentucky Counties with Confirmed EAB Infestations

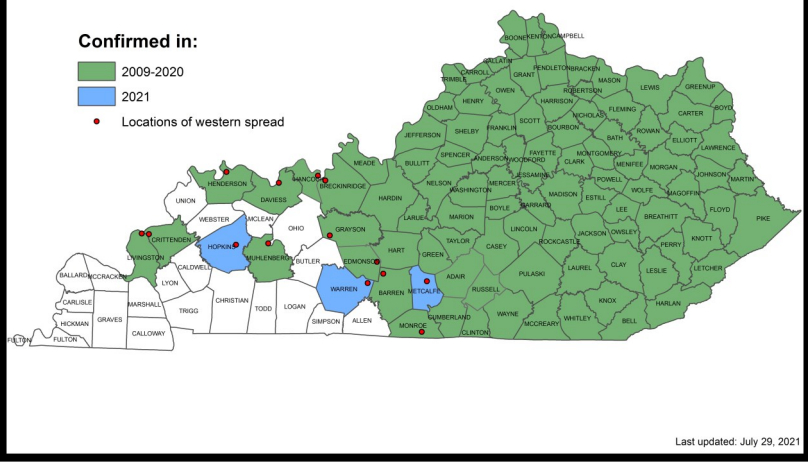
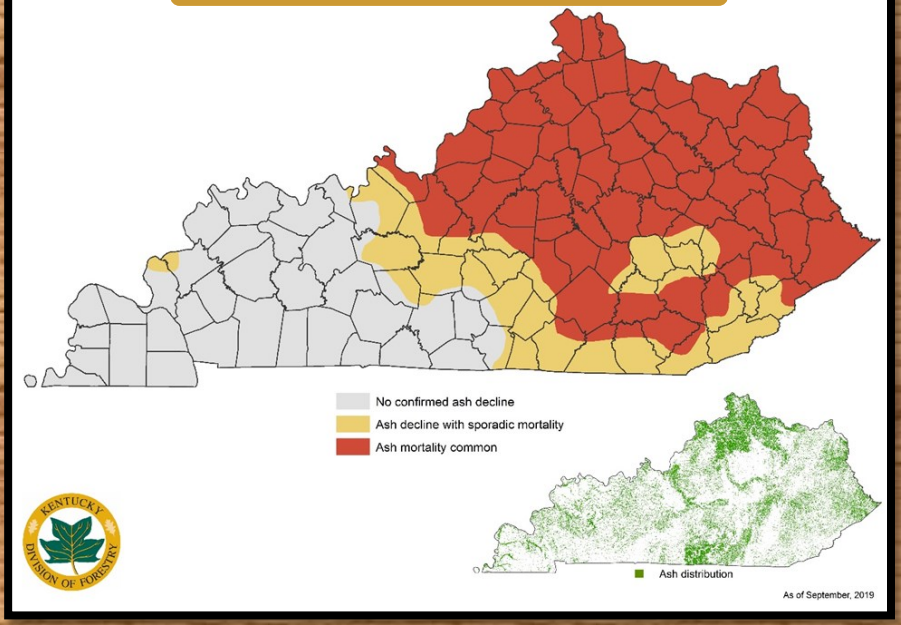


Figure 3: 2019 Ash Damages and Distribution in Kentucky



EXOTIC INSECT PESTS

Hemlock woolly adelgid

The eastern hemlock is considered a foundation species within the riparian habitat in which it's found (Figure 4). However, this integral species is under attack from the hemlock woolly adelgid (HWA). This pest is an exotic species with origins from Japan and was first detected in the eastern United States during the 1950s. It wasn't until 2006 when this insect invader was first discovered in Kentucky. Approximately 98% of Kentucky's hemlocks are found in the eastern one-third of the state. In this region, infestations currently occur in 31 counties resulting in decline and mortality (Figure 5).

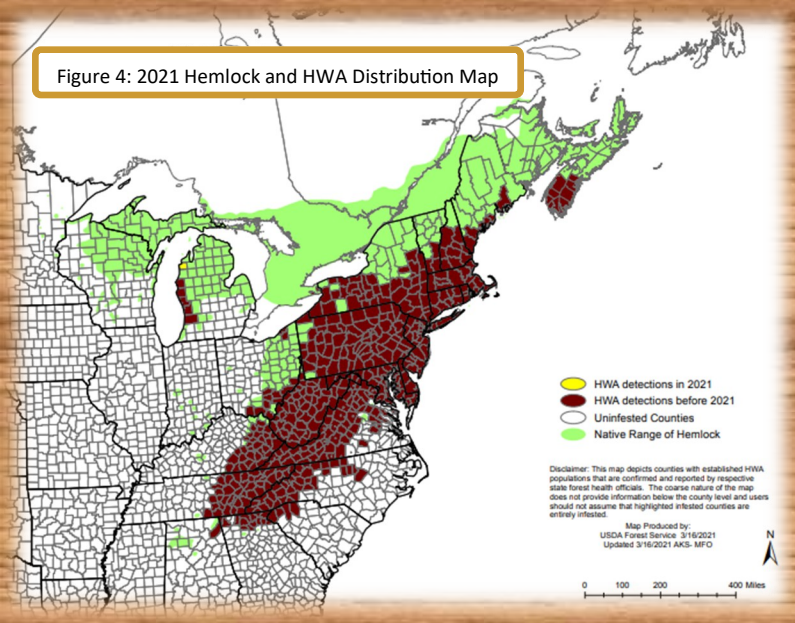


Figure 4: 2021 Hemlock and HWA Distribution Map

The KDF's Forest Health Program has a field crew responsible for treating hemlocks to prolong the survival of this ecologically significant tree. Chemical insecticide treatments are employed in order to suppress HWA populations (Figure 6). Treatments began in 2009 on Kentucky State Forests and has since expanded to include properties managed by Kentucky State Parks, Office of Kentucky Nature Preserves, KDFWR Wildlife Management Areas, and USFS Daniel Boone National Forest (DBNF). Since 2009, KDF has chemically treated over 200,000 hemlock trees.

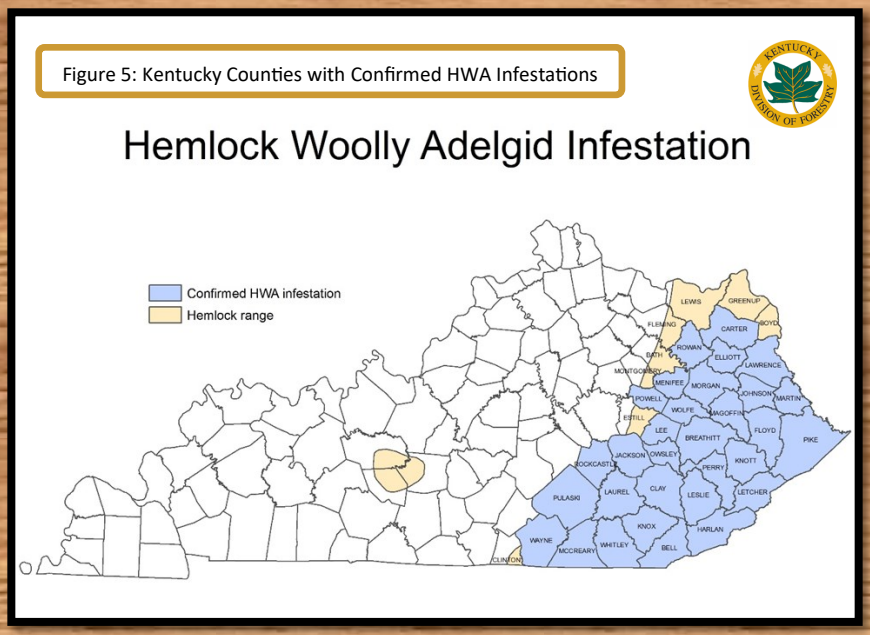


Figure 5: Kentucky Counties with Confirmed HWA Infestations

Recently, KDF has also released two species of predatory beetles that feed especially on HWA within the DBNF in hopes of creating a future field insectary site. In the past, Kentucky has struggled with predatory beetle establishment. However, in 2020 KDF made their first recovery of both the adult and larval forms (Figure 7). Identification was confirmed in 2021 by the Beneficial Insects Lab at Virginia Tech. Future releases will take place adjacent to previous release sites to augment the formerly established population.

We will continue to improve upon this integrated pest management approach in 2022 with further chemical and biological control of this invasive pest.

Figure 7: *Laricobius osakensis,* a species of predatory beetle that specializes on HWA (adult pictured on the left, larva seen on the right)

Figure 6: Chemical treatment of hemlock using a soil drench technique

NATIVE INSECT PESTS

Exotic pests aren't the only insects damaging our woodlands. There are also a number of native insect pests that locally impact our forests every year. Yet, the significance of these native pests fluctuates over time. While these native insects typically don't cause the same level of damage as their non-native counterparts, they can become an issue when coupled with additional stressors such as drought. KDF is constantly on the look-out for damages from such native pests.

Oak Shothole Leafminer

After an extensive outbreak of this native forest pest last year, relatively minimal damage was detected in 2021. In 2020, cosmetic damage from this native fly species was detected across the entire state, whereas this year, damage was sporadic and not widespread. The female fly is the cause of the shothole appearance in leaves, hence the common name for this insect (Figure 8). This unique damage type is created during her feeding and oviposition through the use of her needle-like ovipositor on swollen buds just before leaf-out. As the new leaves expand, the puncture holes magnify. The juvenile form of this insect, a maggot, also causes further damage to the foliage of the host tree by mining within the tissue as it develops. Red and white oaks alike displayed the shothole signature in central, western, and eastern Kentucky counties (Figure 9). No formal surveys took place to record this damage in Kentucky this year, but rather, general observations and outside agency reports were used to record locations that experienced localized damage.

Figure 8: Oak Shothole Leafminer Fly

Figure 9: Shothole Signature in Shingle Oak

During the late summer months of 2021, we had yet another native forest pest cause noticeable damage to trees across the Commonwealth. Browning oak trees were observed across the northern portion of the state during general monitoring efforts, in addition to, outside reports from field branch staff and private landowners. Upon closer examination, feeding damage from the oak lace bug was found to be responsible. Further detection surveys were used to determine the extent of damage from this pest. The majority of northern Kentucky and some parts of central Kentucky, primarily along ridgetops where mature oaks are common, saw at least some level of damage. This should only be a cosmetic problem with no impact to the tree's vigor. However, this damage paired with recent extreme weather events could potentially lead to future decline. For more information, please see the pest alert on the following page.

NATIVE INSECT PESTS

AUGUST 31, 2021

FOREST HEALTH PEST ALERT

OAK LACE BUG

The Issue:

Over the past month, we have noticed browning oak trees (Figure 10) across the landscape. After completing ground surveys and collecting samples, we have identified the culprit to be the native forest pest, the oak lace bug.

Identification and Biology:

The oak lace bug is a native forest pest. They are within the Hemipteran insect order and therefore are equipped with a piercing/sucking mouthpart. Adults (Figure 11) are 1/8" long and light brown with dark spotting along the wings. The juveniles or nymphs are smaller in size, darker in coloration, and are covered in spines. Each female lays 25-50 eggs on the lower leaf surface which will hatch into nymphs (Figure 12) that feed together with the adults as they grow. Several generations occur each year and they overwinter as adults.

Hosts:

All species of oaks, with preference for the white oak group, as well as other hardwood species. Damage during surveys was mainly seen on chinkapin oak.

Symptoms:

Symptoms begin as light stippling of the foliage (Figure 13), but can progress to complete bleaching (Figure 14) of leaves from the top down. Leaf drop can occur with heavy damage.

Distribution:

Feeding damage from this insect has been observed in the following counties: Franklin, Owen, Carroll, Gallatin, Boone, Jefferson, and Shelby. If you see any additional damages, please report.

Recommendation:

No management is needed as trees can typically handle this type of feeding damage and should bounce back next year.

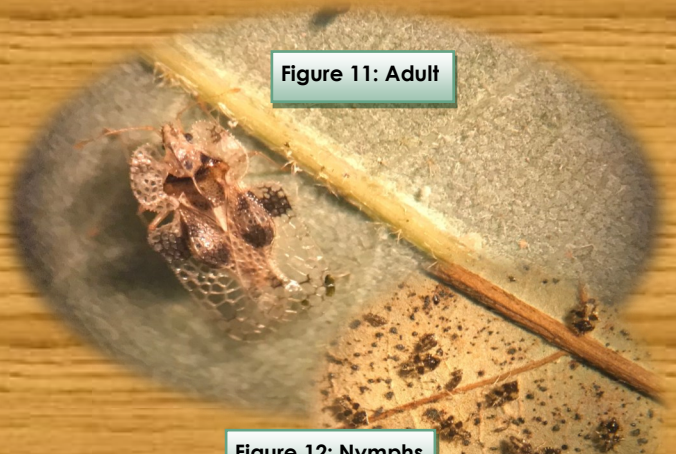


Figure 11: Adult

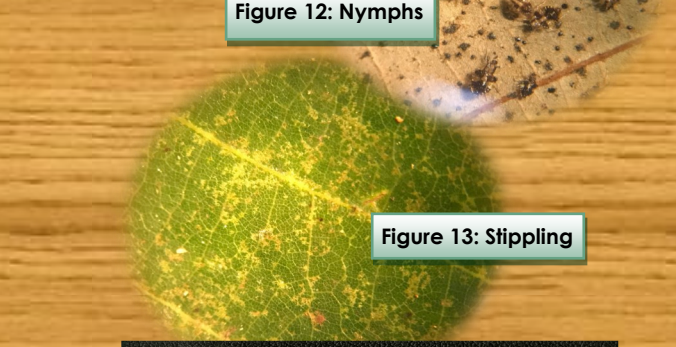


Figure 12: Nymphs

Figure 13: Stippling

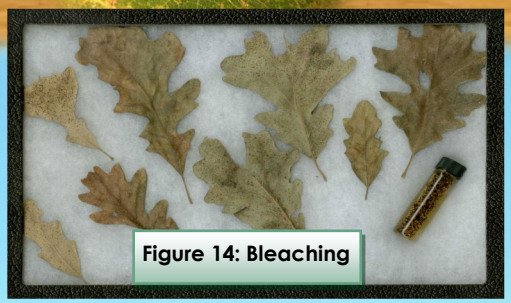


Figure 14: Bleaching

Figure 10: Browning Oak Trees

INVADERS ON THE HORIZON

There is also a myriad of pests that have yet to make their way into Kentucky. These looming threats would cause extensive damage to our forests, which is why they demand our attention and awareness. These pests may never make it to Kentucky. It all depends on the quarantines put in place by the federal government and additional regulatory efforts by various state and private stakeholders. Even under these strict guidelines, we each must do our part to ensure that we aren't moving infested material.

Spongy Moth (formerly known as Gypsy Moth)

Lymantria dispar, or the moth formerly known as gypsy moth, is getting a new common name. It will now be referred to as the spongy moth. The authority on this matter, the Entomological Society of America, will no longer recognize the old name and encourages others to do same.

The spongy moth caterpillar is an aggressive defoliator that possesses a strong preference for oak species (Figure 15). This is unfortunate for our state since the predominant forest-type here is oak-hickory, which covers 76% of our woodlands. Spongy moth surveys have been conducted since 2005 through various agencies and programs. Thankfully this pest is not yet established in Kentucky, although it has been detected every year since the surveys began. The USFS and Kentucky's Office of the State Entomologist annually trap for this invasive species using detection surveys through USDA APHIS and Slow the Spread (STS) programs. In 2021, traps were placed in 85 counties across the state. 29 positive traps were found across 15 counties with a total of 30 moths captured. Counties with positive traps include Bath, Boone, Campbell, Clark, Elliott, Fayette, Harrison, Jefferson, Lewis, Rowan, Scott, Floyd, Lawrence, Martin, Pike. Positive trap catches were up from 7 moths captured in 2020, yet substantially lower than 68 moths in 2016, and 171 moths in 2015. This is an excellent example of a successful early detection and rapid response system. The efforts of the STS program have kept this pest at bay and the pressure off Kentucky (Figure 16).

Figure 15: Spongy Moth Caterpillar

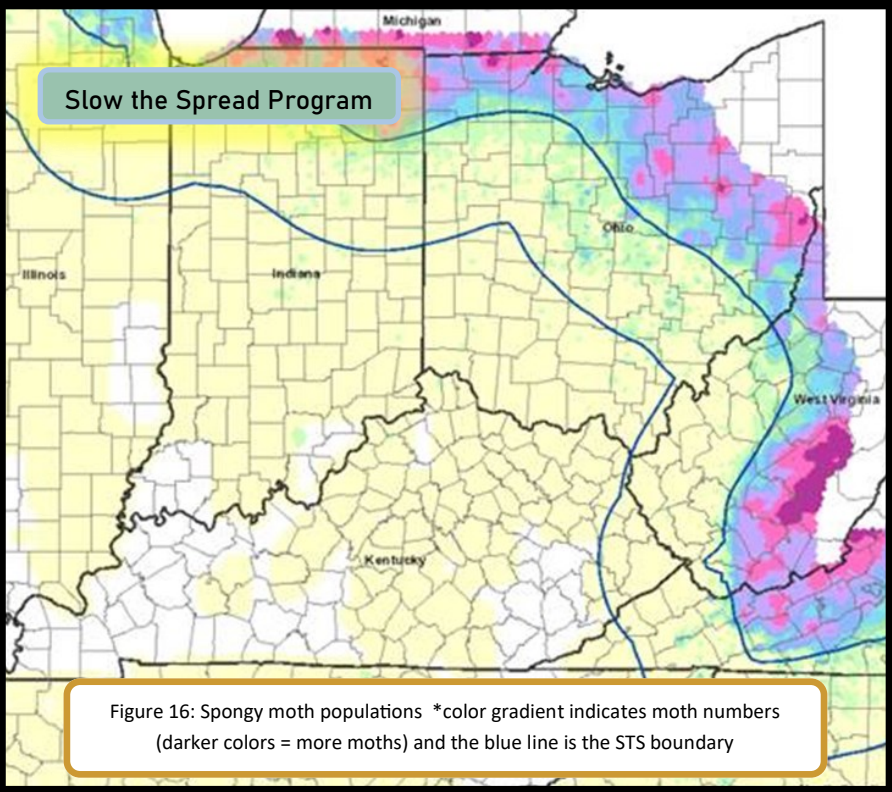


Figure 16: Spongy moth populations *color gradient indicates moth numbers (darker colors = more moths) and the blue line is the STS boundary

INVADERS ON THE HORIZON

Asian Longhorned Beetle

The Asian longhorned beetle (ALB) continues to be a potential pest of concern for Kentucky (Figure 17). Although ALB has not been found within the Commonwealth, in 2011 it was discovered in Clermont County, Ohio, a mere 10 miles from our northern border. More recently, ALB was confirmed in Charleston County, South Carolina in June 2020. Eradication efforts are currently underway. Here are the common signs of ALB activity. The females chew oviposition pits on host trees, most commonly maple, and lay a single egg beneath the bark. Then the larvae hatch and feed on the sapwood for a short period of time before moving into the heartwood. When adults emerge, they create noticeably round exit holes that can be as large as a dime (Figure 18). KDF continues to work with various agencies to educate the public on ALB identification and signs of infestation.

Figure 17: Asian Longhorned Beetle Adult

Figure 18: ALB Feeding Damage

Spotted Lanternfly

The spotted lanternfly (SLF) is a relatively new invasive insect to the US with origins from Asia. It was only first discovered in Pennsylvania in 2014. It can be described as beautiful, but it is also dangerous (Figure 19). Don't be fooled by its name, this insect isn't a fly at all. It is actually a hemipteran which uses its characteristic, piercing and sucking mouthpart to steal nutrients right out of its host plant. It is thought that the tree of heaven is their primary host species, but they also show preference towards red maple, black walnut, and various other fruiting trees and vines. Damage from this insect's aggregate feeding behavior can weaken the host, leaving it susceptible to other stress agents. These insects also produce ample amounts of honeydew, or liquid excrement, that transforms into black sooty mold. Although the SLF hasn't been found in Kentucky, it was recently discovered just two miles north of the border in Vevay, Indiana in July 2021. Currently, there is no federal quarantine in place for this pest. Yet, some states have taken it upon themselves to provide regulations for their infested areas (Figure 20).

Figure 19: Spotted Lanternfly Adult

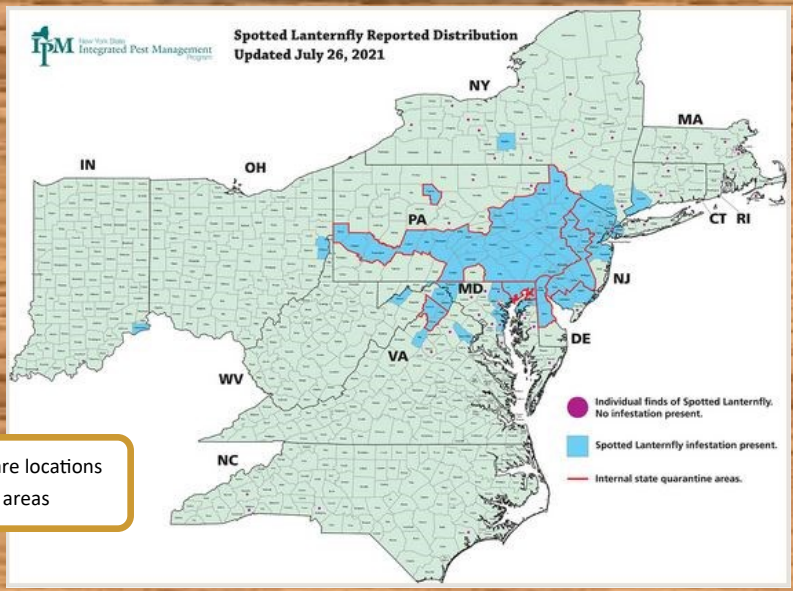


Figure 20: SLF Distribution Map *blue areas indicate infestation, purple dots are locations were SLF have been found, and the red line shows the state quarantine areas

DISEASES

Thousand Cankers Disease

Thousand cankers disease (TCD) of eastern black walnut is caused by the fungal pathogen, *Geosmithia morbida* and its insect vector, the walnut twig beetle. It was first recorded in the eastern United States in 2010. Yet, neither the pathogen nor the vector of TCD have been confirmed in Kentucky even though there have been confirmed cases in the neighboring states of Indiana, Ohio, and Tennessee (Figure 21). A monitoring program has been conducted within the Commonwealth for many years, and thus far, no beetles have been found. In 2021, KDF did not deploy traps to monitor for the walnut twig beetle associated with TCD (Figure 22). However, new ground surveys and trapping efforts will continue in the 2022 field season.

Figure 21: Distribution of Thousand Cankers Disease

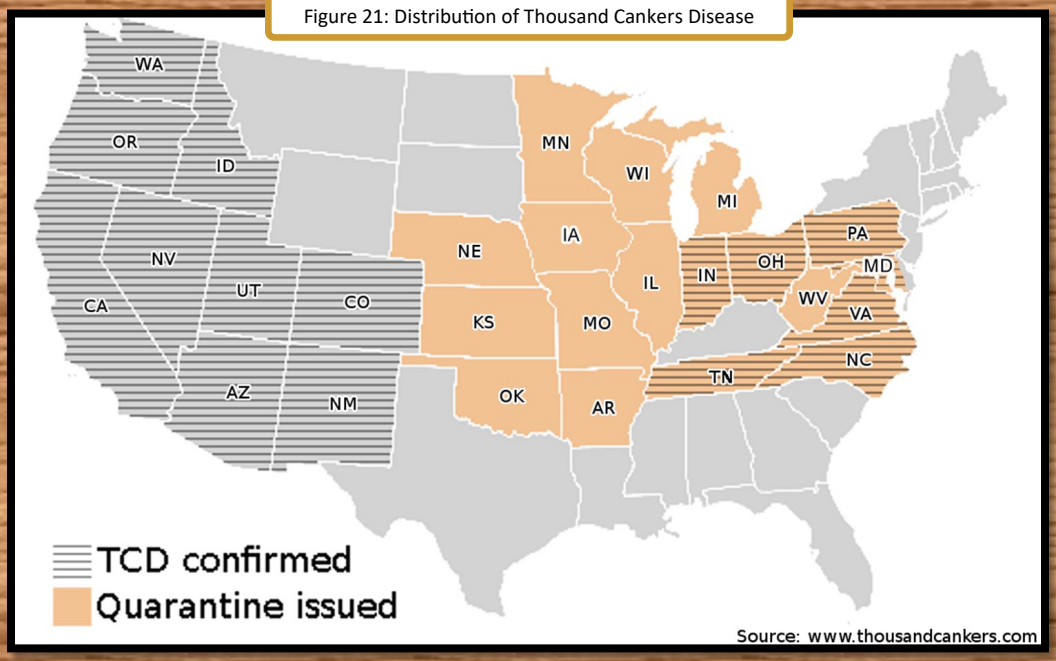


Figure 22: Funnel Trap in a Black Walnut

Bacterial Leaf Scorch

Bacterial leaf scorch (BLS) is vectored by various leafhopper and treehopper species and it affects multiple tree species including elm, maple, sycamore, and oak. This disease is common on many urban landscapes throughout the state. This year numerous landowners and partnering state agencies reported this issue, predominantly from central Kentucky. Symptoms include a scorched leaf appearance that presents itself in July and progressively gets worse through the end of summer (Figure 23). Symptoms occur annually as the disease progresses through the crown. Reduced growth and branch dieback soon follow, resulting in slow decline and eventual death of the tree (Figure 24).

Figure 23: Scorch Symptoms

Figure 24: Decline due to BLS

DISEASES

Figure 27: Sapwood Staining

Laurel Wilt Disease

In 2019, Laurel Wilt Disease (LWD) was first documented in Kentucky in Christian, Todd, and Logan Counties. LWD was first confirmed inside the Fort Campbell Army Base after large sassafras trees were reported dead. After this initial detection, ground surveys were used to learn the extent of the outbreak. Just this past year, three additional counties were added to the map. Those counties include: Caldwell, Hart, and Warren (Figure 25). LWD has now been confirmed in counties ranging from the extreme southern and northern borders of Kentucky. It appears that the positive detections are following major interstate corridors, such as I-65 which travels from southwestern Kentucky into the city of Louisville. Investigation of these potential vector pathways will be a top priority next season.

Redbay ambrosia beetles vector this disease by boring into trees and transmitting the pathogen within the wood. A single beetle can transmit enough spores of the lethal fungal pathogen, *Raffaellea lauricola*, to kill a tree. The fungus infects the xylem, blocking off the vascular system, causing rapid wilt and eventual mortality. Death can occur within weeks to months after being infected. Yet, there is evidence to suggest that sassafras can surpass the initial infection and survive for an extra year or two before succumbing to the disease. Signs of beetle activity include very small circular holes in the bark, occasionally accompanied by thin sawdust toothpicks of waste. Other symptoms to look for include early fall coloration or wilting of leaves on suspect trees that may remain attached for months (Figure 26). In most infected trees and shrubs the fungus causes distinctive, dark staining within the sapwood (Figure 27).

It is important to note that this disease complex is specific to plants within the Laurel Family. Sassafras and spicebush are the only two species found in Kentucky that LWD is known to attack. As of now, we only know of severe impacts to sassafras. However, the first observations of infection in wild spicebush were documented and confirmed within the Fort Campbell Army Base in 2020. There will be more to come with work surrounding this alternative host plant.

Next year, a pilot study in cooperation with the University of Kentucky and Bartlett Tree Experts will examine the efficacy of a fungicide treatment as a method to combat this disease in municipal trees. Trials will begin in spring of 2022. The Commonwealth could need this more than we know as the national champion, and possibly, the world's largest sassafras tree is located in Owensboro, Kentucky.

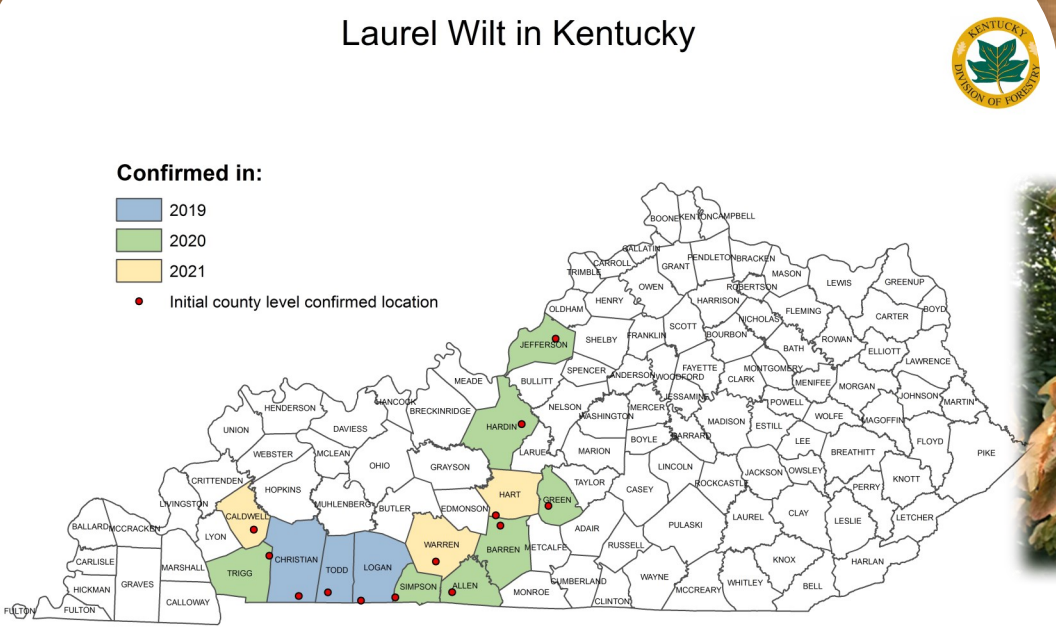


Figure 25: 2021 Laurel Wilt Distribution Map

Figure 26: Foliar Symptoms of LWD

DISEASES

Laurel Wilt Disease Continued…

As previously mentioned, the first-ever infected spicebush has been found in the wild. This is terrible, yet exciting, news since past research had suggested that the redbay ambrosia beetle didn't show a strong preference for spicebush in the laboratory setting. We now have evidence from the field to suggest otherwise. Please make yourself aware of the following tell-tale signs as we need all the help we can get to find new locations of infection across the region. As you can see, spicebush displays the same symptoms as sassafras when affected by LWD. Early fall coloration in the form of golden hued foliage can be seen in the summer months (Figure 28). Frass toothpicks left behind by the beetle vector litter the boles of infected spicebush (Figure 29). The iconic staining of the sapwood can be seen in the cross-section of this freshly cut sample (Figure 30). And the final stages of wilt that dry out not only the leaves, but also the fruit, which marks the lethal blow (Figure 31).

Figure 28: Early Fall Coloration in Spicebush

Figure 29: Frass Toothpicks Hanging from Spicebush Bole

Figure 30: Spicebush Sapwood Staining

Figure 31: Wilted Leaves and Fruit of Spicebush

Save Your Sassafras

Do you want to be part of a new forest health project that could help save thousands of trees?

There is promising research that shows certain fungicides can help stop the spread of the lethal fungus and protect healthy trees from LWD, but more field trials are needed. The University of Kentucky, in partnership with the Kentucky Division of Forestry and Bartlett Tree Experts, is looking for landowners willing to participate in a series of fungicide trials to protect our native sassafras trees from LWD. The results will greatly improve our knowledge of how to combat this disease, help save trees throughout Kentucky, and influence the science and treatment options related to LWD for many years to come.

You are eligible to participate in the trials if you live in any of the positive detection counties. If you're concerned about your sassafras, but don't want to participate in the trials, anyone can treat their trees! Please reach out for more information on how you can do this and for opportunities to get involved with our citizen science program.

INTERESTED? email Alexandra.Blevins@ky.gov or call 502-382-1720

EXTREME WEATHER

Beginning on February 10, 2021 three consecutive winter storms, bringing all forms of precipitation (e.g. snow, sleet, freezing rain, and ice), hit Kentucky over the course of a week's time. The hardest hit counties included Elliot, Lawrence, and Jackson which received approximately 0.4 - 0.7 inches of ice as well as additional snow accumulation. This was enough weight to cause severe damage to trees and power lines. The impact to these areas was so great that 44 KDF foresters were called to duty and deployed on 30 saw teams, in addition to 5 plow operators, to aid in debris clearance from vital roadways and power lines.

While these counties received the brunt of the first storm, the bout of extreme weather continued within the Commonwealth along with further damages. All regions of the state received some level of damage from this trifecta of storms, but certain regions of the state were more severely impacted. The most critical damages occurred in the eastern portion of the state. From Monticello in the south to Ashland in the north, and any counties falling in-between these two locations, received the most extreme impacts.

Ground surveys were completed in the northeast, which resulted in the following observations. Uprooted pines along roadway edges were reported in Carter and Lawrence counties as well as injuries to hardwood crowns in the area. These damages ranged from broken tops to branch damage. A threshold in branch diameter size was observed, in that branches which were approximately eight to ten inches in diameter broke most often. It is also important to note that this damage was not uniform across the landscape. In fact, it was sporadic in severity and patchy in distribution. Evidence from Grayson Lake State Park suggests that aspect and slope dictated the level of impact to trees in these mountainous regions. These two characteristics determined the amount of ice that accumulated on trees, with trees on steeper inclines collecting more which also encouraged trees to uproot more easily. Further aerial detection surveys of the widespread damage resulted in the same findings. Another general observation made during the ground surveys was that edge habitats and roadsides were also damaged more frequently. Smaller to medium-sized trees in these areas had broken tops, whereas more mature trees had mostly branch breakage. Snapped branches tended to be 10 inches in diameter or larger, while smaller-sized branches were more pliable and able to bend with the extra weight. This was a reoccurring threshold that was seen across the landscape during the broader aerial surveys.

Merely two weeks after these devastating winter storms that left some Kentuckians without power for several days, the Commonwealth was hit again with torrential downpours. This precipitation event set records for the state with new benchmarks established for the amount of rainfall over a short duration and historic levels of flooding spanning from the west to the east. On February 28 heavy rains, in addition to the recent run-off from the snow and ice storms, started accumulating in all Kentucky River tributaries. Flooding occurred in all locations, which resulted in the largest flash flooding event ever documented in the state record books.

Extreme weather events that used to be few and far between are now becoming a common occurrence year to year. While no major decline was recorded this year, documentation of these events will be essential for future forest health monitoring efforts.

EXTREME WEATHER

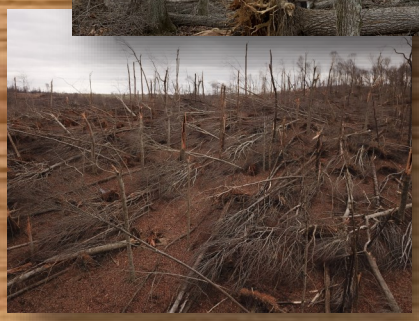
2021 Severe Weather Continued...

2021 was a devastating year for severe weather in Kentucky with multiple extreme events causing noticeable damage throughout the Commonwealth. The year ended in the worst way imaginable with the most catastrophic tornado outbreak in US history. Lives, homes, and whole communities were lost.

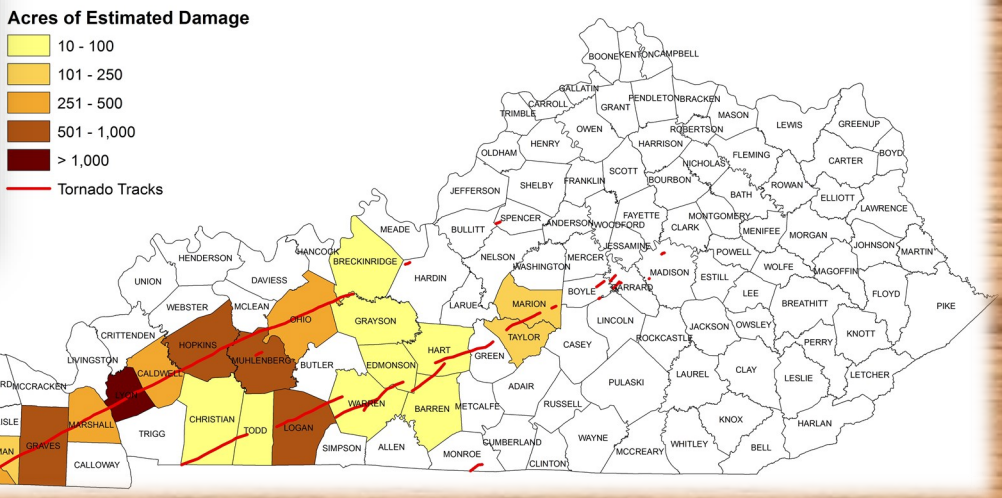
On the night of December 10th into the early morning hours of December 11th, a massive storm system moved through the state. During this time, Kentucky was hit by 7 tornados. The National Weather Service (NWS) confirmed a total of 21 touchdowns by radar as well as on-the-ground surveys. These supercells left behind a path of massive destruction in their wake. Widespread and significant damage was recorded. The final report from the NWS classified these damages, using the Enhanced Fujita scale, as ranging from an EF0 to an EF4. An EF4 tornado has enough power to turn large vehicles into projectile missiles! And this is what Kentuckians witnessed in the aftermath of this outbreak.

The worst of these tornados, the long-track EF4, covered approximately 165 miles within Kentucky alone! It wreaked havoc in counties all the way from Fulton to Breckinridge, reaching top wind speeds of 190 MPH. A state of emergency was immediately declared and KDF foresters were called into action once again. A total of 36 foresters were deployed to aid in rescue and recovery missions in western and central regions of the state. They removed debris, down trees, and broken limbs from powerlines and roadways to clear access for emergency responders. Over 11,000 disaster claims were made following these violent storms and we are still working to clean up the residual chaos.

Once it was possible, our Forest Health Program got a drone in the air to inspect the severity of damage to our forestlands. As you can see from the images below taken in Taylor County, which was hit by an EF3, the damage was indiscriminate. The straight-line winds caused trees to completely uproot, tops to be broken, trunks snapped in half, and branches became a mangled mess. After the drone survey, an aerial detection survey took place to track the worst damages within each tornado's path. The damages seen from the drone survey were mirrored during this broad-scale detection flight. In addition, it was observed that all species, hardwoods as well as pines, and all age classes experienced some level of damage from these brutal winds. Over 7,300 acres of timber damage were documented. Using the data collected during the aerial survey, KDF was able to provide a map of the county level damages to timber in western and central Kentucky. All KDF Programs are continuing to work together to provide further assistance to our fellow Kentuckians affected by this tornado outbreak. Once landowners are ready to reforest their lands, we will be ready and waiting to serve.



Acres of Estimated Timber Damage
December 10 & 11 Tornadoes



Forest Health Assistance in Kentucky

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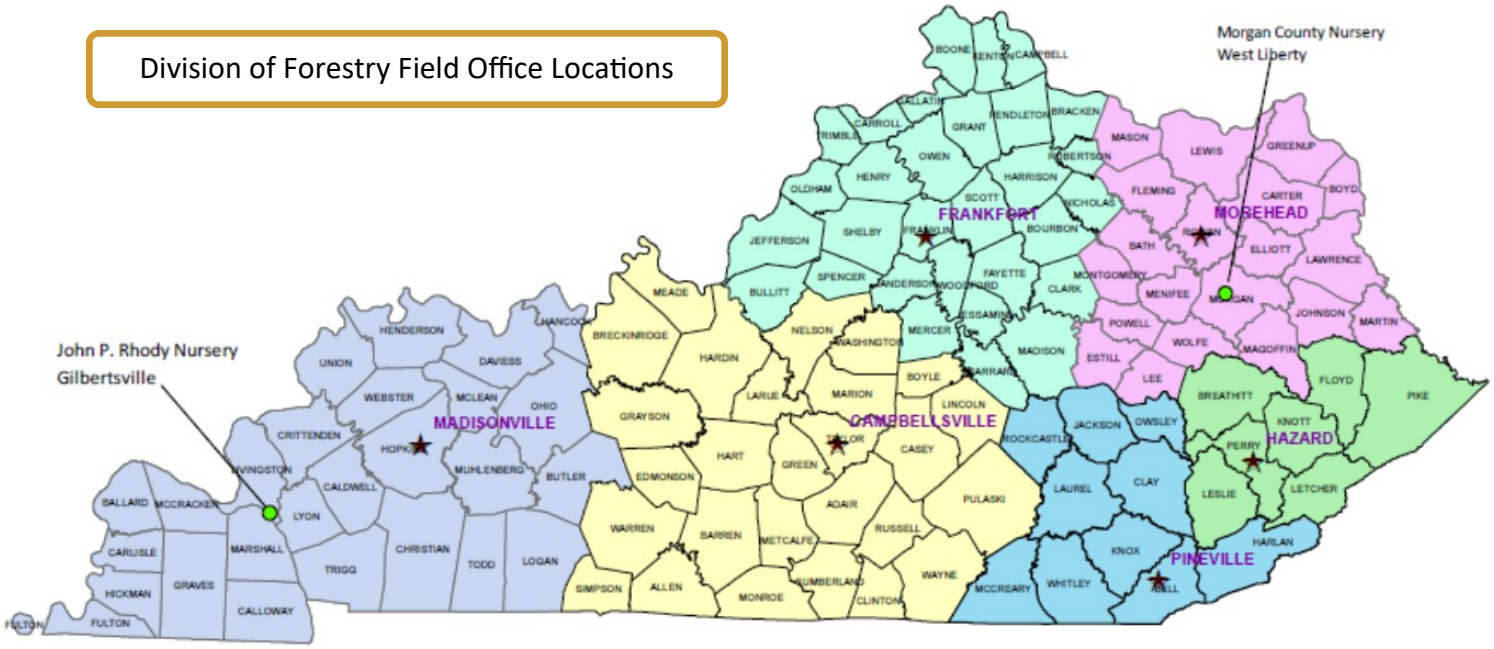
Division of Forestry Field Office Locations



Field Office Contact Information

Campbellsville	Frankfort	Morehead	Hazard	Madisonville	Pineville
Seth Dykes	Matt Haywood	James MacDonald	Jake Hall - Detailed	Chuck Porter	Deanio Carmical
120 Gaines Drive	105 Corporate Dr, Ste I	255 Rodburn Hollow	154 Grand Vue Plaza	625 Hospital Drive	12008 US Hwy 25E
Campbellsville, KY 42718	Frankfort, KY 40602	Morehead, KY 40351	Hazard, KY 41701	Madisonville, KY 42431	Pineville, KY 40977
270-465-5071	502-573-1085	606-783-8625	606-435-6073	270-824-7527	606-337-3939

References:

- USDA APHIS provided the Federal Quarantine Maps
- Photos with image numbers are courtesy of Bugwood.org