

Pennsylvania Forest Health Highlights 2021

Forest damage surveys

Aerial survey was not conducted in 2021 due to Covid-19 and aerial contract problems. Detection data this year are from limited ground surveys, Forest Insect and Disease reports (FID), and other related projects. The major damage agents are emerald ash borer, *Lymantria dispar*, periodical cicada (brood X), locust leafminer, fall webworm and fall cankerworm (Figure 1 and Tables 1-2).

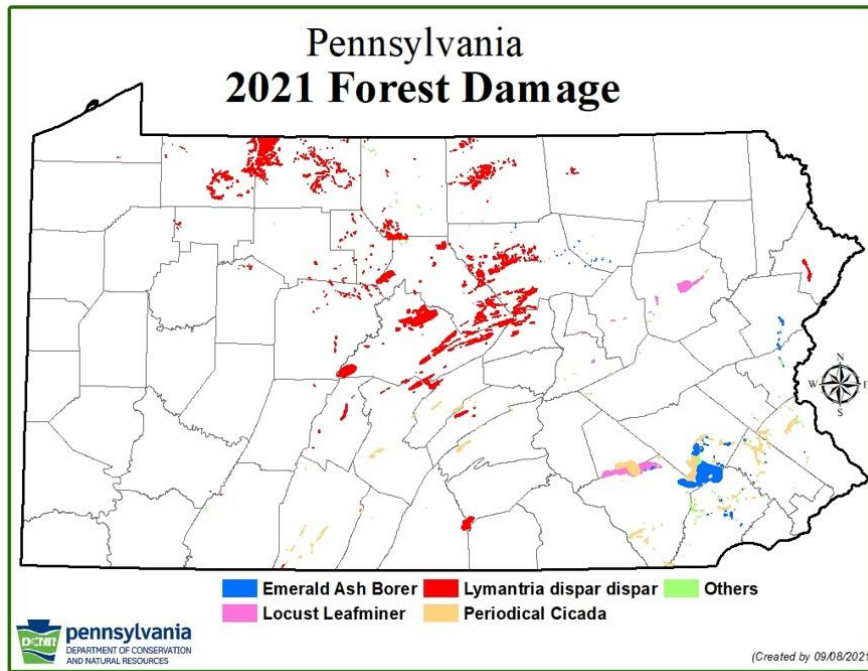


Figure 1. 2021 Pennsylvania major mapped damage agents

Table 1. Acres of damage by agent in Pennsylvania in 2021

2021 Forest Damages Reported	
Damage Causing Agent	Acres
Emerald Ash borer	1,303,704
Lymantria dispar	326,123
Periodical Cicada	127,551
Locust Leafminer	55,187
Fall Webworm	25,396
Fall Cankerworm	20,291
Others	24,100
Total	1,882,353

Table 2. All recorded damage agents and acres damage in 2021

Others Category	
Damage Causing Agent	Acres
Anthraconose	7,835
Oak Shothole Leafminer	6,492
White Pine Needle Damage	1,163
Neuroterus tantalus	1,109
Tulip Poplar Weevil	1,005
Unknown	910
White pine declines/Caliciopsis	883
Beech Bark Disease Complex	868
Hemlock Woolly Adelgid	807
Drought	505
Beech Leaf Disease	398
Elongate Hemlock Scale	359
Pine Bark Adelgid	316
Hemlock Borer	256
Drought/WPND/Others	159
Oak Decline	132
Canker	131
Eastern Tent Caterpillar	129
Spotted Lanternfly	115
Peach Bark Beetle	110
Neonectria ditissima	100
Wind-Tornado/Hurricane	51
Caliciopsis Canker	45
Fabrella Needle Cast	35
Forest Tent Caterpillar	24
Paranthrene Robiniae	17
Fire	15
Oak Wilt	15
Beech Scale	15
Apple Wood Stainer	11
Cherry Scallop Shell Moth	10
Eriophyid Mites/Erineum Galls	10
Leaf Spot	10
Sawfly or Bagworm	9
Rhizosphaera Needlecast	7
Botryosphaeria Twig Canker	6
Hemlock Leafminer	5
Leaf Scorch	5
Oak Sawfly	5
Witch Hazel Leaf Spot	5
Southern Pine Beetle	4
Maple Gall Mite	2
Decline	1
Hackberry Gall Psyllid	1
Hackberry Nipple Galls	1
Magnolia Scale	1
Oak Lace Bugs	1
Succulent Oak Gall Wasp	1
White Pine Weevil	1
Woolly Elm Aphid	1
Woolly Pine Scale	1
Yellow Poplar Weevil	1

Hemlock woolly adelgid

Treatments are ongoing at the time of this publication but 138,000 inches of imidacloprid soil injections, 47,000 inches of dinotefuran soil injections and 7,000 inches of imidacloprid soil tablets are planned and in progress. From late 2020 through 2021 there were 757 *Laricobius osakensis* and 2,050 *Laricobius nigrinus* released to continue efforts at establishing a biological control program. There was also a trial release of 2,276 *Leucopis* spp (silverflies), a newer biological control agent hailing from the pacific northwest. *Leucopis* survived the trial release and are being monitored. Small numbers of *Laricobius osakensis* larvae and adults have been recovered at six release sites. We continue to monitor a potentially hemlock woolly adelgid resistant test plot of hemlock in Tiadaghton State Forest District, from trees provided to us by the US Forest Service and researchers at the University of Rhode Island. We also funded research by the University of Rhode Island looking for additional HWA resistant hemlock in Pennsylvania.

Emerald ash borer

All counties in Pennsylvania are now positive for emerald ash borer (Figure 2). There were approximately 1500 ash trees retreated with emamectin benzoate, as year eight in DCNR’s 10-year emerald ash borer management plan. In attempts to establish a successful biological control program for emerald ash borer, parasitoid releases (all wasps) have been conducted since 2011. In 2021 there were 2,875 *Oobius agrili*, 1,680 *Spathius galinae*, and 3,947 *Tetrastichus planipennisi* released. *Tetrastichus planipennisi*, *Spathius galinae*, and *Oobius agrili* have been recovered from release sites, either by placing logs from felled trees in rearing tubes offsite or using yellow pan traps on location.

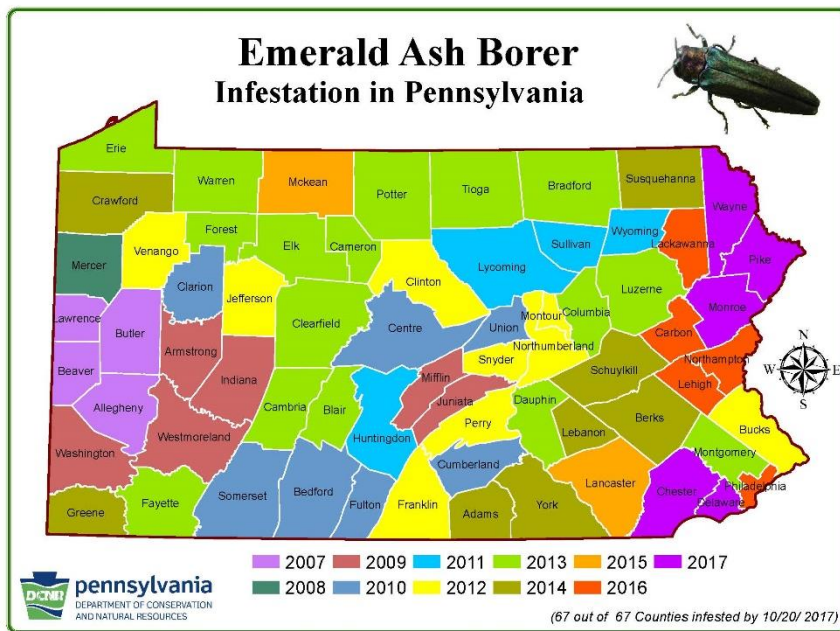


Figure 2. Pennsylvania county map showing year of confirmed infestation by emerald ash borer.

Forest tent caterpillar

Forest tent caterpillar moth trapping was resumed after the 2020 hiatus from Covid-19. While populations are increasing, the numbers are still very low and are not concerning yet (Figure 3).

Pennsylvania is due for a forest tent caterpillar outbreak and has been monitoring populations closely since 2019.

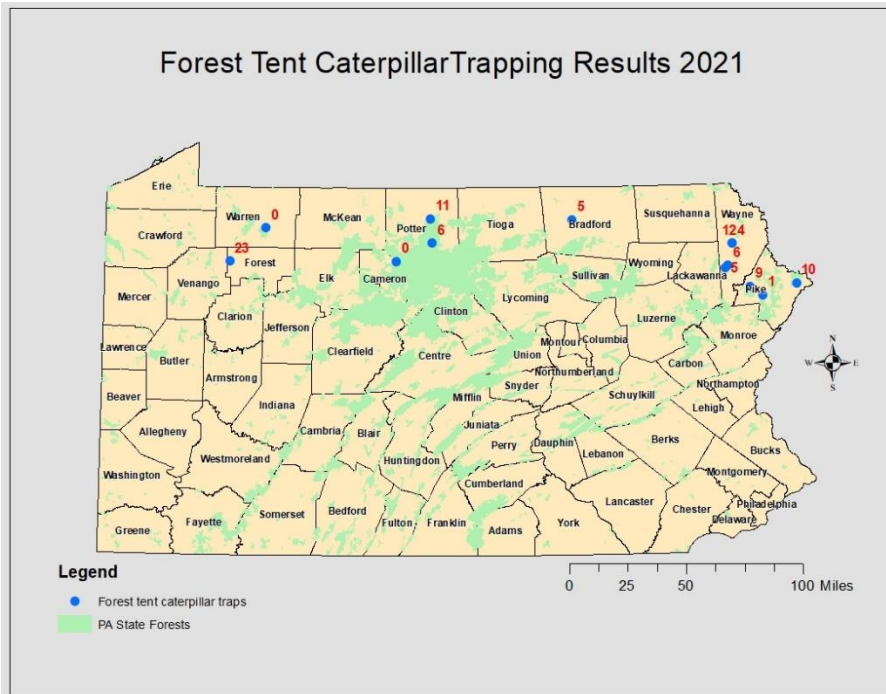


Figure 3. Pennsylvania county map showing state forests and locations results of forest tent caterpillar traps

Southern pine beetle
 Southern pine beetle trapping was resumed after the 2020 hiatus from Covid-19. Populations in the Goat Hill Serpentine Barrens have increased to similar levels observed in 2017, which was followed by a two-year decline. There were two positive trap catches in areas where the beetle had not been recorded since trapping began (Figure 4).

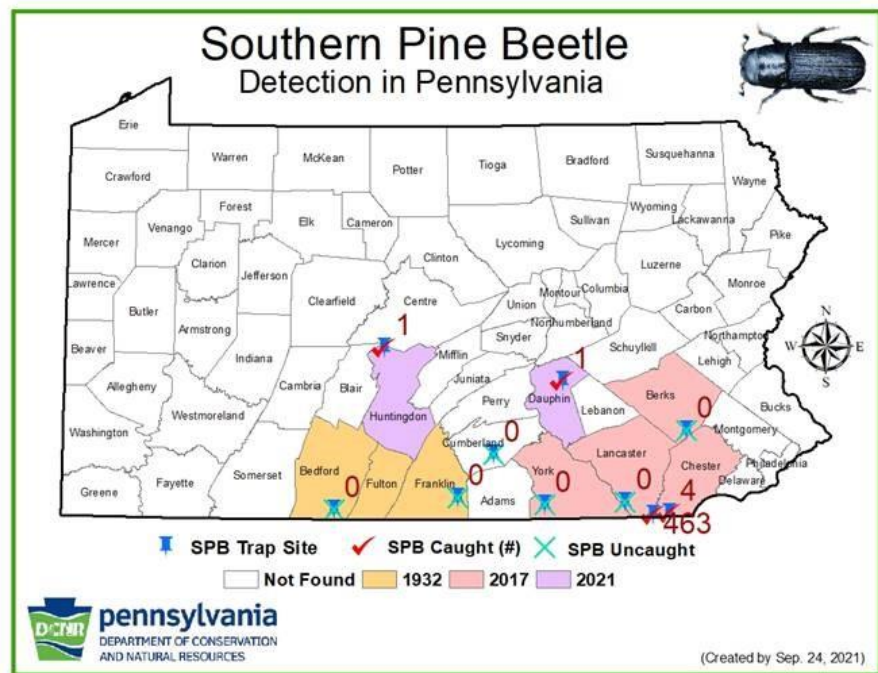


Figure 4. Pennsylvania county map showing southern pine beetle trap locations and results.

Lymantria dispar dispar

There was a large *Lymantria dispar* suppression program in 2021, with 203,569 acres being sprayed. Spray aircraft used on the project were helicopters and fixed wing airplanes, with tebufenozide and *Bacillus thuringiensis* subspecies *kurstaki* (Btk) being applied (Table 3 and Figure 5). While state forest and made up the bulk of the acreage treated, small portions of state park, Pennsylvania Game Commission, and Federal land were also treated.

Table 3. 2021 *Lymantria dispar dispar* spray acreages

Ownership	Btk Helicopter	Btk Airplane	Mimic Airplane	Total Acres
State Forest	23,917	58,366	64,995	147,278
State Parks	4041	0	0	4,041
Game Commission	0	0	49,400	49,400
Federal	2,850	0	0	2,850
Total Acres	30,808	58,366	114,395	302,569

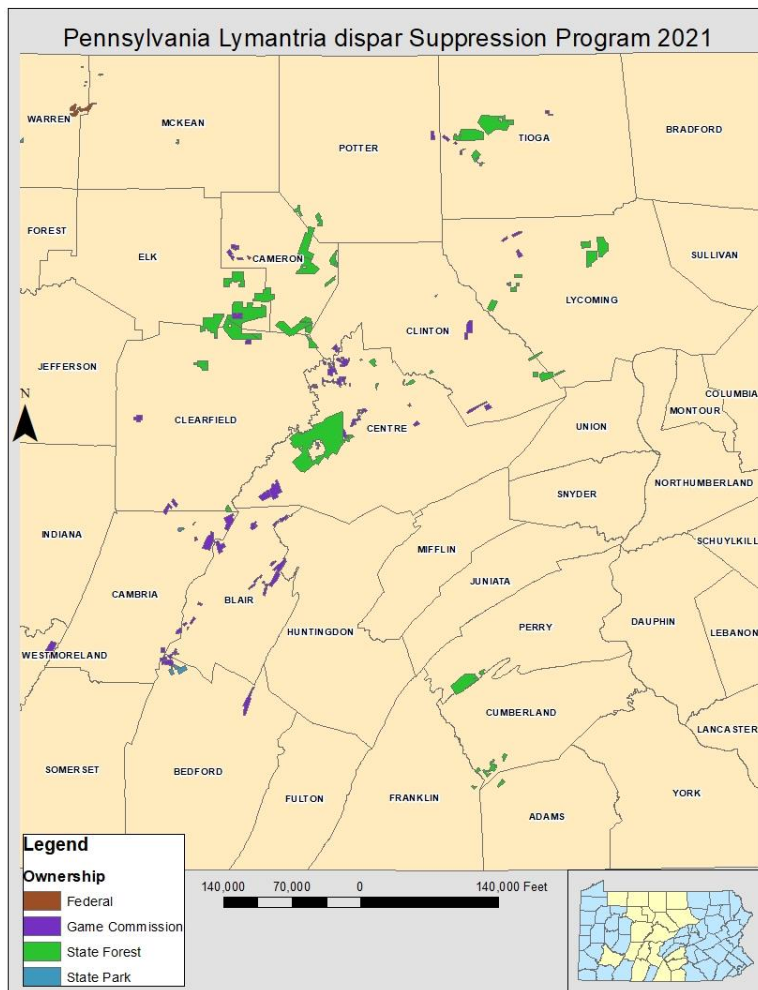


Figure 5. Pennsylvania map showing land ownership of locations where suppression treatments took place.

White pine

Brown spot needle blight (*Lecanosticta acicola*) was the primary pathogen of white pine, being more severe in the central and north central parts of the state (Figure 6). *Bifusella linearis* was also present but limited and not currently a major factor. Permanent white pine monitoring plots are being established across the state.



Figure 6. White pine with brown spot needle blight

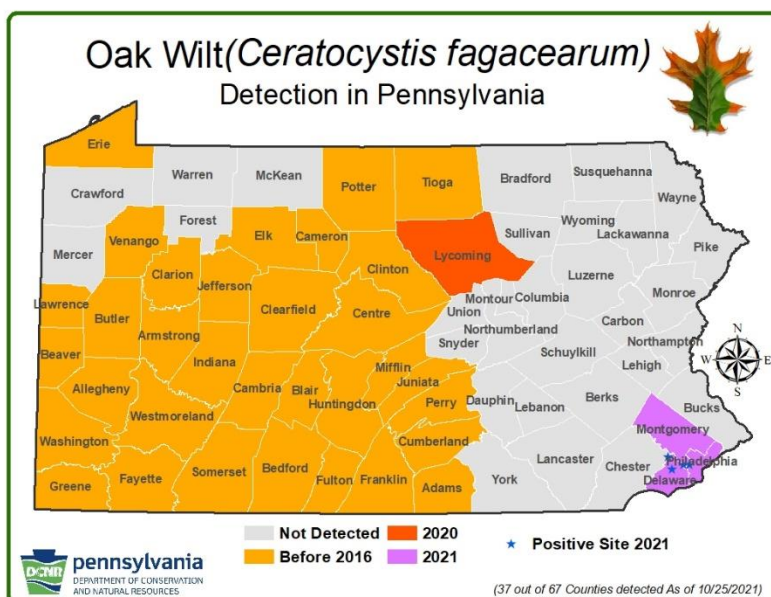


Figure 7. County map of Pennsylvania showing years oak wilt was confirm by county.

Oak wilt

Oak wilt (*Ceratocystis fagacearum*) is confirmed in over half the counties of the state, but no new counties had been added since 2016. This has all changed recently, with confirmation of oak wilt in Lycoming County in 2020, and Montgomery, Philadelphia, and Delaware Counties in 2021, the first counties east of the Susquehanna River to be positive (Figure 7). A technique for managing oak wilt using herbicide in lieu of trenching was recently developed in Wisconsin and is being assessed by DCNR and Penn State

Extension for use in Pennsylvania.

Other Oak Mortality Issues

There is concern with white spongy rot associated with chestnut oak mortality but currently there is no specific diagnosis available. There is also concern with Diplodia canker, bacterial leaf scorch, and associated declines on red oak. Damage has also occurred due to excess moisture in early spring followed by drought and frost events later that season.

Beech leaf disease

Beech leaf disease has been confirmed in half of the counties in the state, with many added in the last two years (Figure 8). All beech trees in the forest can be affected (seedlings, saplings, mature trees). Observed symptoms are leaf curling and necrosis followed by twig and branch dieback, or tree mortality within 2-3 years (Figure 9-10). Seven additional permanent beech monitoring plots were set up in 2020, with 15 total plots now established. A non-native nematode (*Litylenchus crenatae*) has been linked to beech leaf disease and research is ongoing to further illuminate the relationship of this organism to the pathogen.

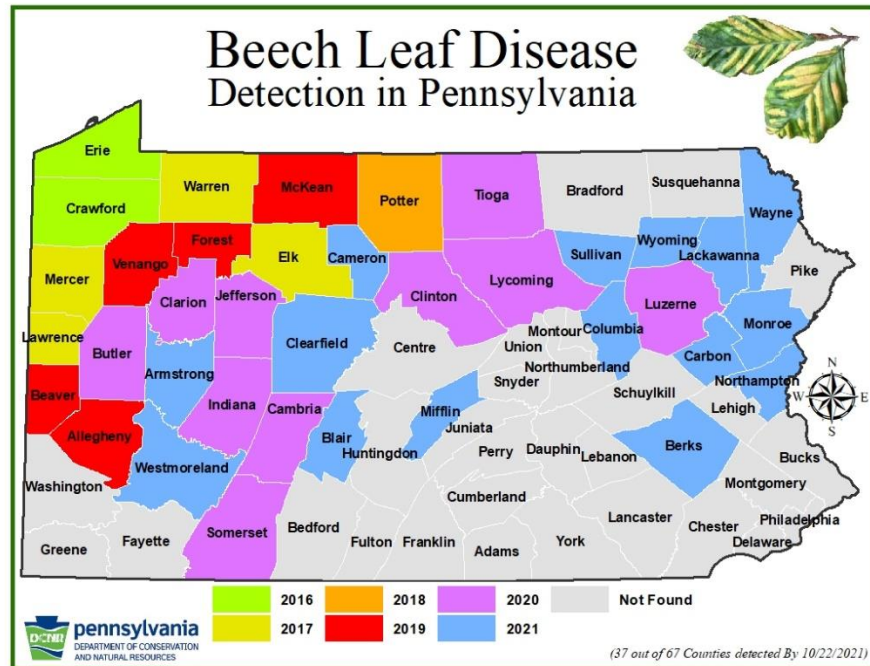


Figure 8. County Map of Pennsylvania show year of confirmed infestation by beech leaf disease by county.



Figure 9. Beech leaf with early stages of BLD.



Figure 10. Beech leaf with BLD

Anthracnose

High moisture and precipitation levels have led to a major increase of anthracnose (a fungal pathogen), throughout the growth period (Figure 11). Damage is heavy to severe statewide and has been observed on oak, maple, beech, birch, and sycamore. Weakened by infestations of anthracnose during previous

two years, chestnut oaks in certain areas were killed or suffered from severe dieback due to invasions of two-lined chestnut borer along with armillaria and other damage factors.



Figure 11. Image of anthracnose damaged leaves.

Abiotic Conditions

The months of April-mid-June were drier than average, which continued to facilitate the current *Lymantria dispar* outbreak by limiting *Entomophaga maimaiga* sporulation and spread. We experienced no late hard frosts, which meant leaf and seed development was not interrupted as in 2020. In mid-June, conditions started to become quite wet. As of October, conditions across PA are wetter than normal for the vast majority of counties (Figure 12). This has facilitated the intensity and spread of leaf diseases, particularly Anthracnose on sugar maple in north central PA.

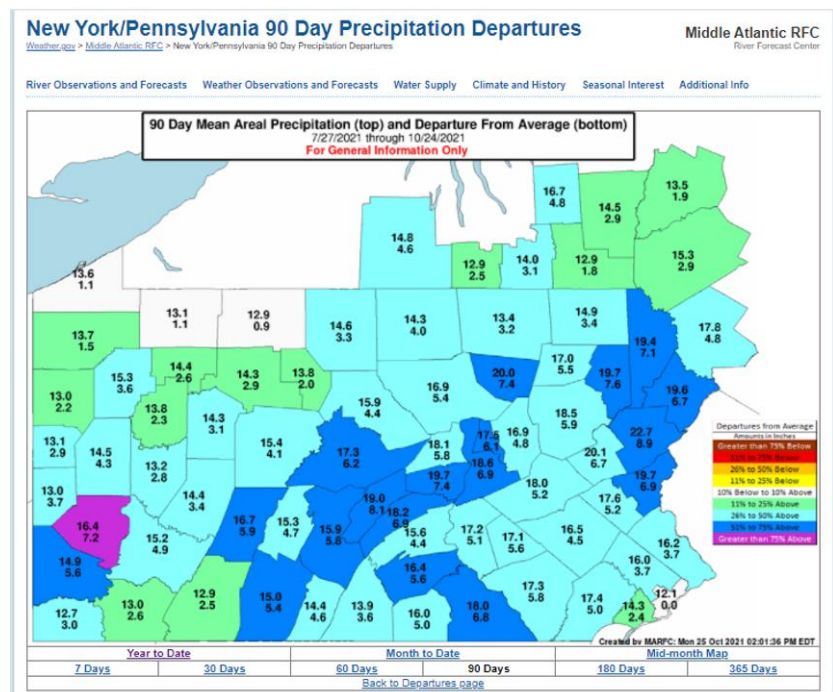


Figure 12. County map of portions of Pennsylvania and New York showing precipitation departures form average.

Spotted Lanternfly

Research by DCNR found that spotted lanternfly (*Lycorma delicatula*) and tree-of-heaven (*Ailanthus altissima*) are closely connected in natural habitats. Tree-of-heaven was involved in every life stage of spotted lanternfly, and a preferred species for egg laying and adult feeding. Spotted lanternfly fed on a wider variety of plant species when the insects were immature (black walnut, black birch, maples, American beech, multiflora rose, tree-of-heaven), but preferred tree of heaven as adults.

The Pennsylvania Department of Agriculture is the main agency managing this pest and more information can be found at their website, (http://www.agriculture.pa.gov/protect/plantindustry/spotted_lanternfly/Pages/default.aspx).

Northern Walking Stick

On the third year of an outbreak in Bedford County northern walking stick (*Diaperomera femorata*) populations have declined. Outbreaks have traditionally occurred here every 9-10 years, lasting 2-3 years each time.