

# Pennsylvania Forest Health Highlights 2022

## Forest damage surveys

Pennsylvania has resumed general aerial survey in 2022 after a two-year (2020-2021) interruption due to Covid-19 pandemic. Forest damages were mapped through aerial detections (Figure 1) and reported via ground observations. In 2022, over 1.0 million acres of wooded areas, primarily in northcentral and northeastern Pennsylvania, were reported with damages. Of all damage causal agents documented in 2022, spongy moth (*Lymantria dispar dispar*) was the dominant defoliator, causing over 80% of total damage acreage, followed by locust leafminer and needlecast (Figure 2, 3).

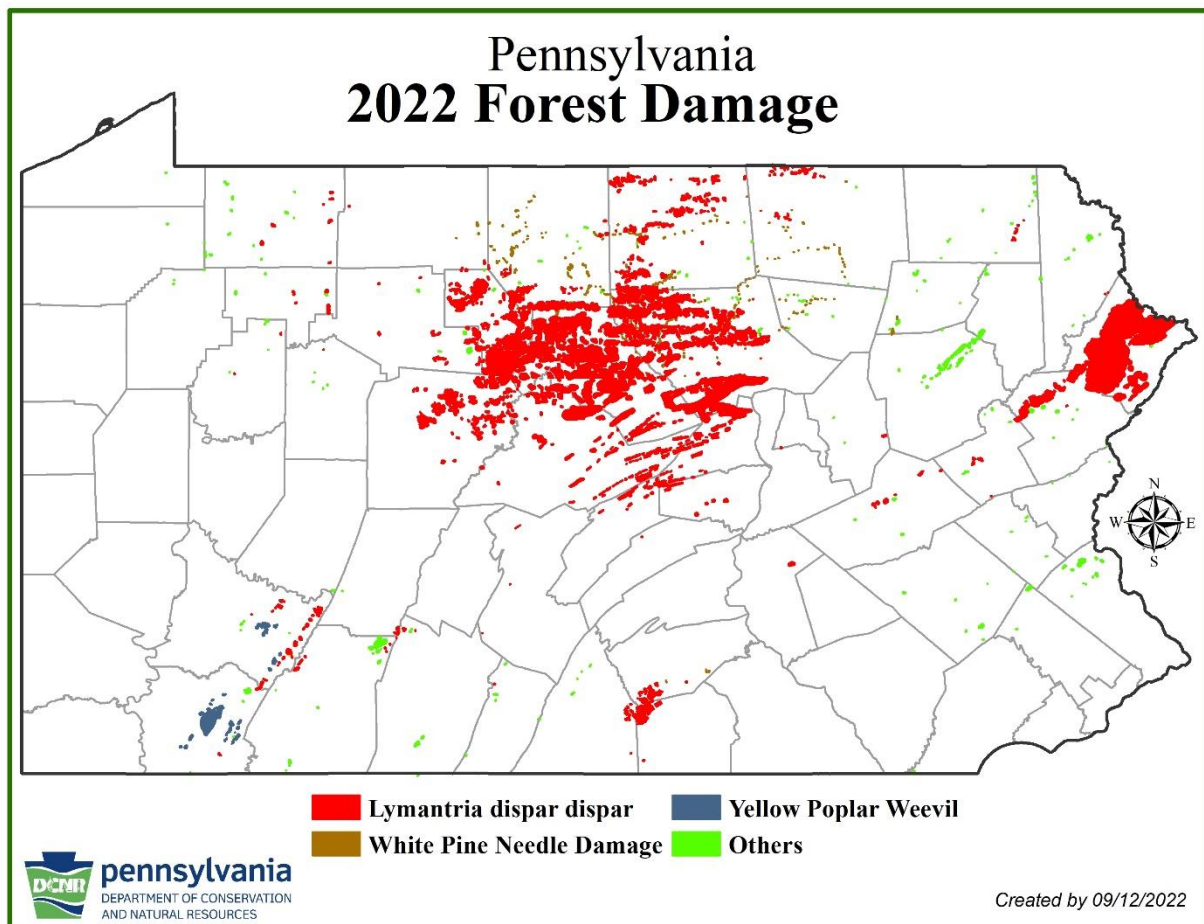


Figure 1. 2022 forest damages mapped through aerial survey.

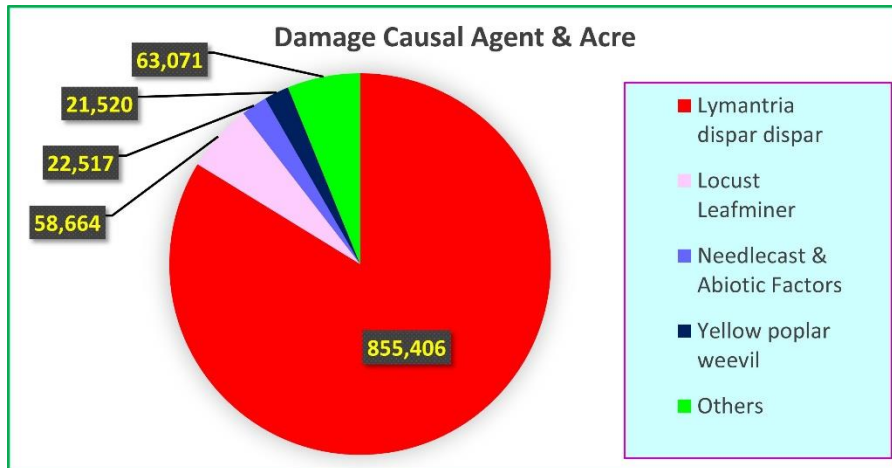


Figure 2. Top forest damage agents recorded in 2022 by acres impacted.

Other Pests	Acre	Other Pests (Cont.)	Acre
Abiotic Factors	404	Leaf and Shoot Blight	1
Ailanthus Webworm	1	Leaf Spot	102
Anthraco nose	3,234	Multiple Factors	821
Asian Jumping Worm	1	Nectria Target Canker	10
Beech Bark Disease Complex	4,667	Oak Decline (Armillaria)	39
Beech Blight Aphids	1	Oak Shothole Leafminer	11,799
Beech Leaf Disease	8,781	Oak Skeletonizer	501
Beech Scale	1	Oak Twig Pruner	108
Black Cherry Decline	116	Oak Wilt	12
Carpinus Decline	500	Peach Bark Beetle	1
Cherry Scallop Shell Moth	1	Phomopsis Gall	1
Eastern Tent Caterpillar	17	Pine Needle Scale	2
Elongate Hemlock Scale	639	Promethea Silkmoth	1
Emerald Ash Borer	10	Southern Pine Beetle	65
Fabrella Needle Blight	161	Spotted Lanternfly	15
Fall Cankerworm	203	Tulip Poplar Weevil	11
Fall Webworm	10,205	Tulip Scale	1
Fire	544	Unknown	2,492
Forest Tent Caterpillar	11	White Pine Blister Rust	8
Hemlock Borer	14	White Pine Needle Damage+	9,773
Hemlock Woolly Adelgid	4,471	Wind-Tornado/Hurricane	807
Hickory Tussock Moth	1	Witches Broom	1

Figure 3. List of damage agents included in 'others' agents included in Figure 1 and 2.

## Hemlock woolly adelgid

In 2022, hemlock woolly adelgid (HWA) was detected for the first time in Greene and Mercer Counties. As of Oct. 15, 2022, almost all Pennsylvania counties (66 out of 67) were infested with this invasive pest (Figure 4).

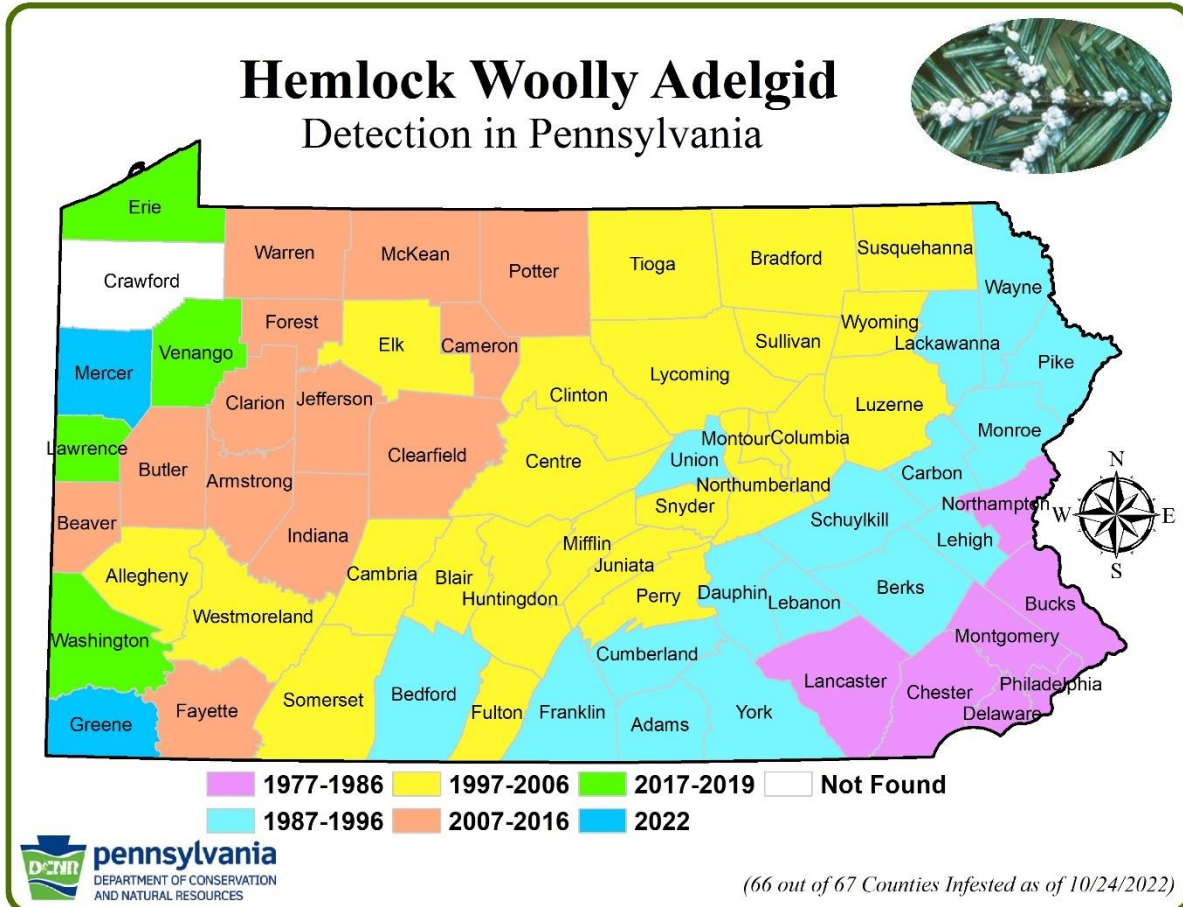


Figure 4. County map of Pennsylvania showing year counties recorded positive for HWA.

The winter of 2021-2022 included one decent cold snap in January. HWA mortality estimates ranged from 20% to 100%, with most samples being 93%+. However, recovery in the progrediens generation was strong and populations overall seemed to have not decreased any from the high mortality estimates.

HWA/ elongate hemlock scale (EHS) suppression treatments are ongoing at the time of this publication but in spring of 2022, 4,175" were treated with imidacloprid. In fall 2022, treatments proposed include 134,922" of imidacloprid and 47,440" of dinotefuran. These treatments are either planned or in progress.

As of the current date there were 512 *Laricobius osakensis* and 1,000 *L. nigrinus* released to continue efforts at establishing a biological control program. Field collections for redistribution occurred in late 2021 at Rocky Gap, MD (Ln) with Maryland DNR staff, and at Wykoff Run, PA (Lo) with USFS staff. The *Leucotaraxis* released in Wykoff Run area will continue to be monitored for survival, but no further releases occurred in 2022. In spring of 2022, 11 release sites yielded *L. nigrinus* larvae recoveries, and 1 release site yielded *L. osakensis* (Figure 5), through collaborative work with Ryan Crandall at UMass Amherst. A few *L. nigrinus* larvae were recovered at a site 8 miles (as the crow flies) from the nearest release site.



Figure 5. Recovery *Laricobius osakensis* adult by Jim Altemus.

We continue to monitor a potentially HWA 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. The Bureau has approved research into the effects of EHS (*Fiorina externa*) on hemlock health in the absence of HWA, to elucidate at what population of EHS it really becomes necessary to switch treatment active ingredients from the cheaper & longer-lasting imidacloprid to dinotefuran. The Bureau also approved funding for hemlock IPM research to include chemical, biological & silvicultural integrated controls.

## Emerald ash borer

All counties in Pennsylvania are now positive for emerald ash borer (Figure 6). There were 78 ash trees retreated with emamectin benzoate, as year nine in DCNR's 10-year emerald ash borer management

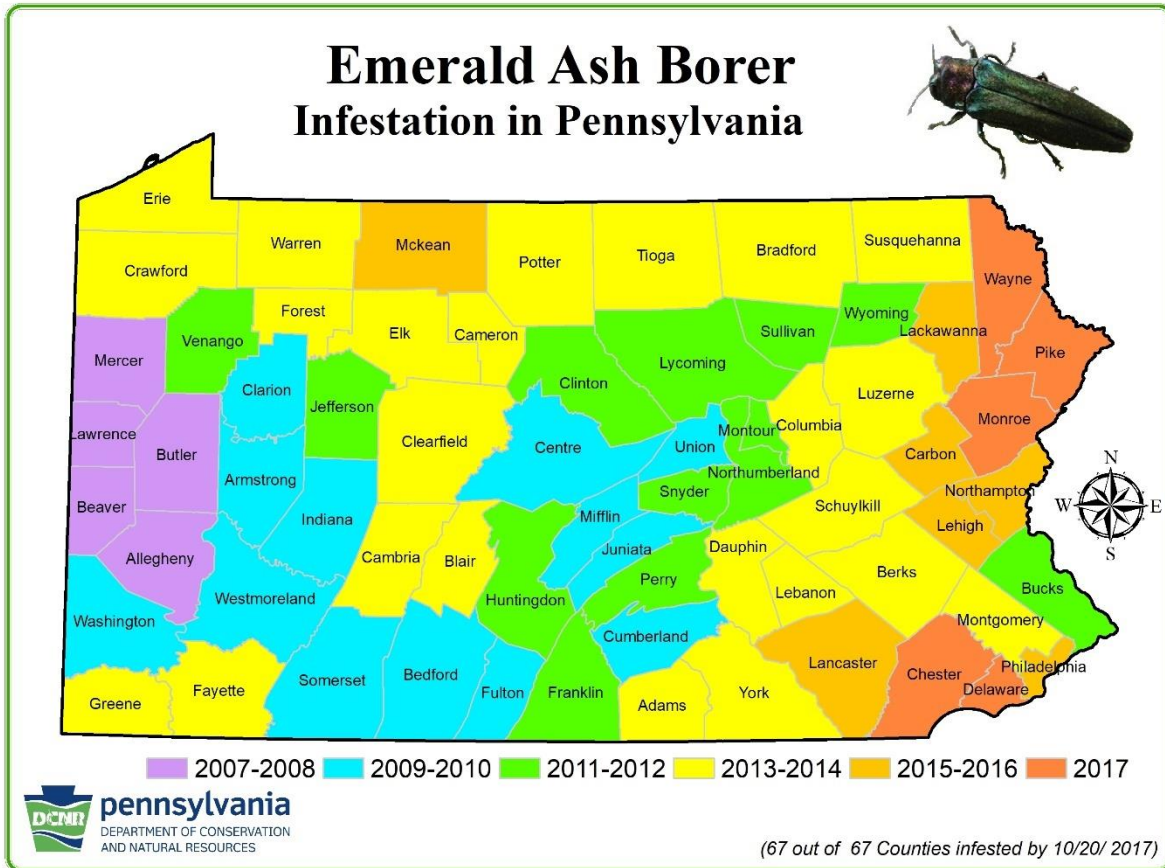


Figure 6. County map of Pennsylvania showing year counties recorded positive for EAB.

plan. In attempts to establish a successful biological control program for emerald ash borer, parasitoid releases (all wasps) have been conducted since 2011. In 2022 there were 1,000 *Oobius agrili* and 1,357 *Spathius galinae* released. Parasitoid recovery using yellow pan traps was attempted at one site with results pending.

## Forest tent caterpillar

Forest tent caterpillar moth was monitored at 6 sites in 5 northeastern counties (Figure 7). Only a few moths were caught with the total catch decreased by 82% compared with 2021. Pennsylvania is due for a forest tent caterpillar outbreak and has been monitoring populations closely since 2019.

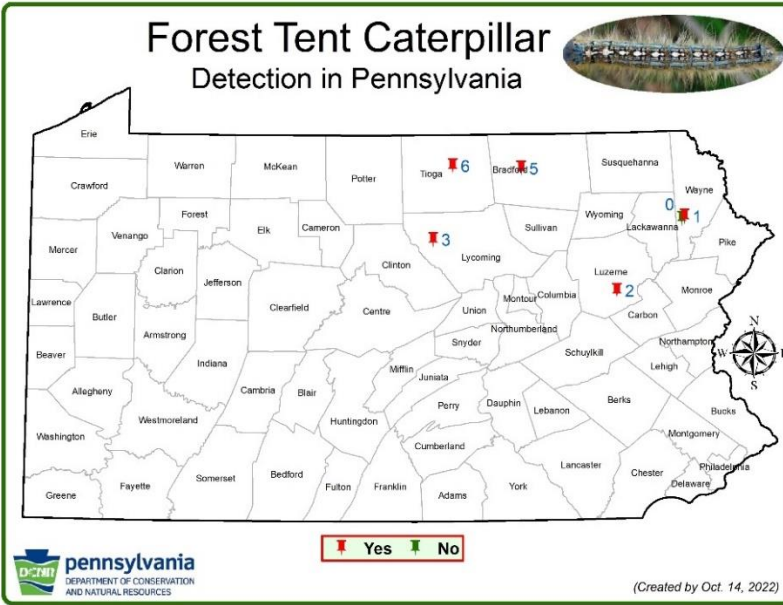


Figure 7. Forest tent caterpillar trap detection in Pennsylvania.

### Southern pine beetle

Southern pine beetle (SPB) was monitored at 10 sites in 9 southern counties with traps (Figure 8). There was one positive trap catch in Cumberland County and that was the first record about present of SPB in the county. Population in the Goat Hill increased slightly compared to 2021 while big increase in beetle catch was observed in Chrome. Small number of beetles were also caught in Bicker Clearing, Dry Hollow, French Creek, and Kings Gap.

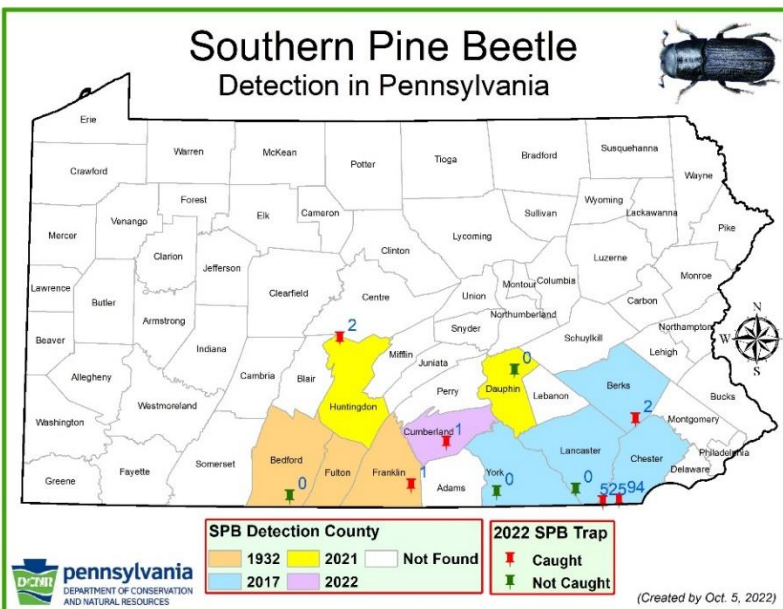


Figure 8. Southern pine beetle trap detection in Pennsylvania.

Spongy moth (*Lymantria dispar dispar*)

Pennsylvania has continued monitoring spongy moth population through evaluating its egg mass density. In 2021-2022 season, a total of 3997 plots were sampled state-widely and the sites with 520 egg mass per acre or above located primarily in northcentral and northeastern areas, forecasting a moderate to heavy defoliation in those areas (Figure 9).

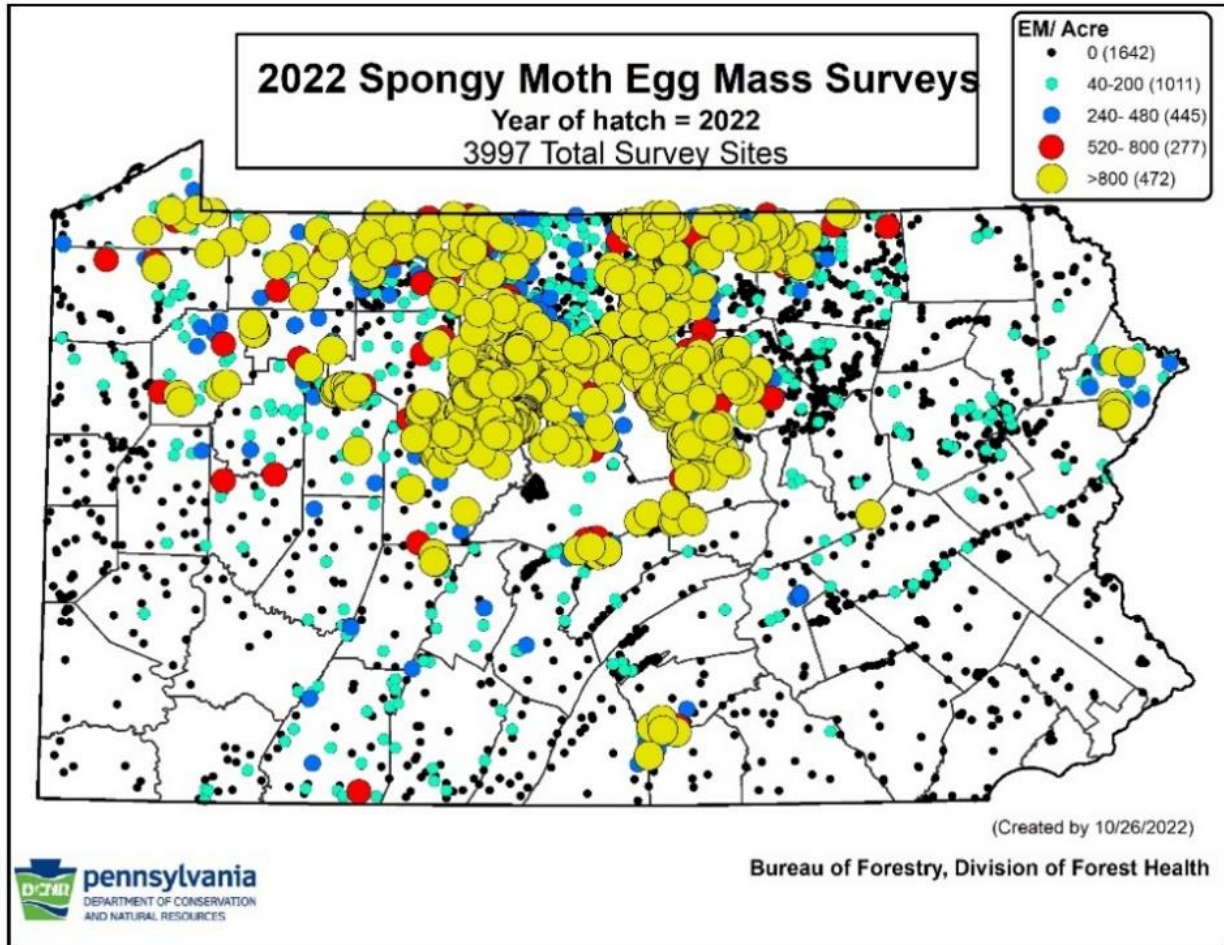


Figure 9. Map of 2022 spongy moth egg mass survey.

Pennsylvania Department of Conservation & Natural Resources (DCNR) had implemented an aerial spongy moth suppression program in 2022. The operational period for the suppression program was May 15 through May 28 and included aerial applications within 20 counties. A total of 220 spray blocks totaling 209,838 acres were treated with either *Bacillus thuringiensis* subspecies *kurstaki* (Btk) or tebufenozide (Mimic 2LV). Participants included State Forest lands, State Parks and some Federal lands (Allegheny National Forest) (Figure 10 - 11).

A separate suppression program on spongy moth was also conducted in the same period by Pennsylvania Game Commission (PGC) in 2022. A total of 109 spray blocks totaling 62,934 acres were treated on PGC lands.

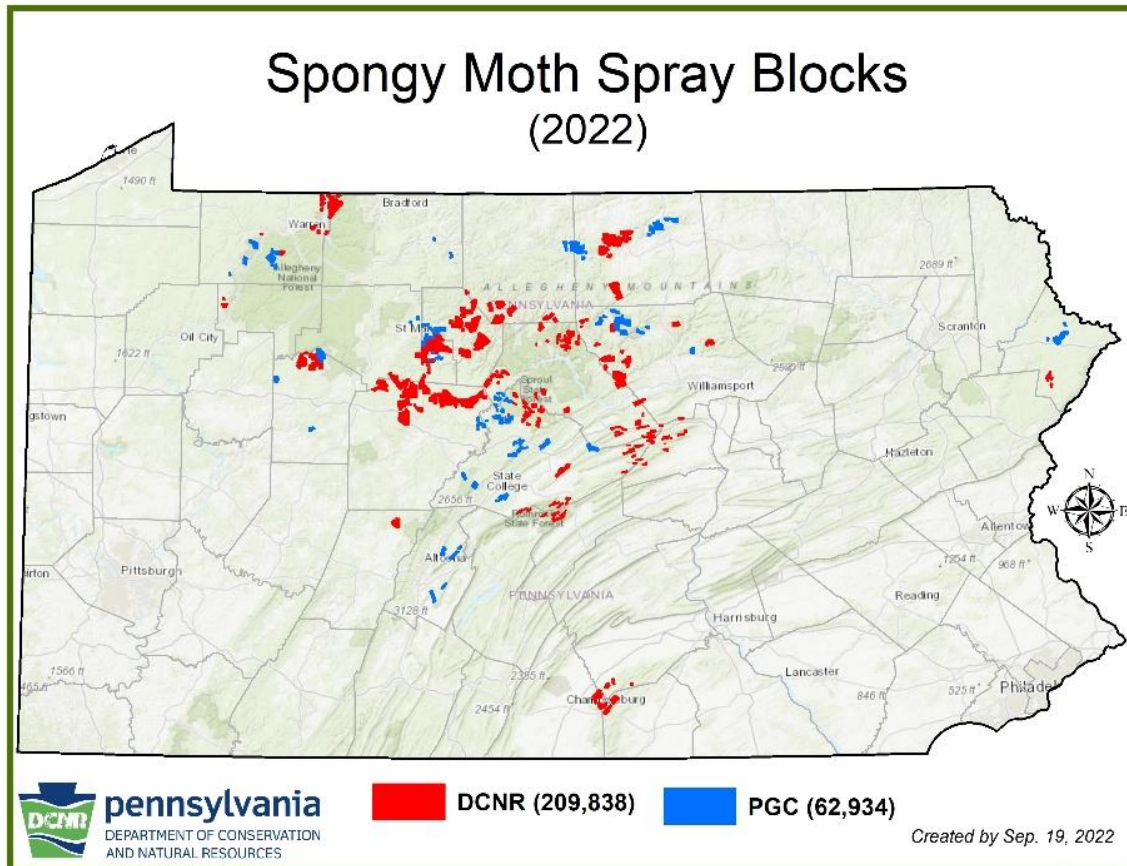


Figure 10. 2022 Spongy moth spray blocks by DCNR and PGC.

2022 <i>Lymantria dispar dispar</i> spray acreage				
Ownership	Helicopter Bt	Fixed Wing Bt	Fixed Wing Mimic	Total Acres
State Forest	1,247	26,128	165,981	193,356
State Parks	4,608	0	0	4,608
Federal	11,874	0	0	11,874
<b>Total Acres</b>	<b>17,729</b>	<b>26,128</b>	<b>165,981</b>	<b>209,838</b>

Figure 11. (DCNR) 2022 spongy moth spray acreage by ownership, aerial craft, and insecticide.

### Oak wilt

Oak wilt (*Bretziella fagacearum*) is confirmed in over half the counties of the state, but no new counties had been added since 2020 when it was detected in Lycoming County (Figure 12). Last year, there were alleged positive oak wilt sites in Montgomery, Philadelphia, and Delaware Counties reported by Davey Tree. They had received positive PCR results from a lab they contracted with in Texas. However, it was proven in 2022 that those results were false positives and oak wilt has yet to be detected east of the



Susquehanna River. Outbreaks and expansion of oak wilt in the Northern areas are continuing to occur. Districts are mitigating either by removing the trees and/or herbiciding and girdling the trees based on our oak wilt management recommendations.

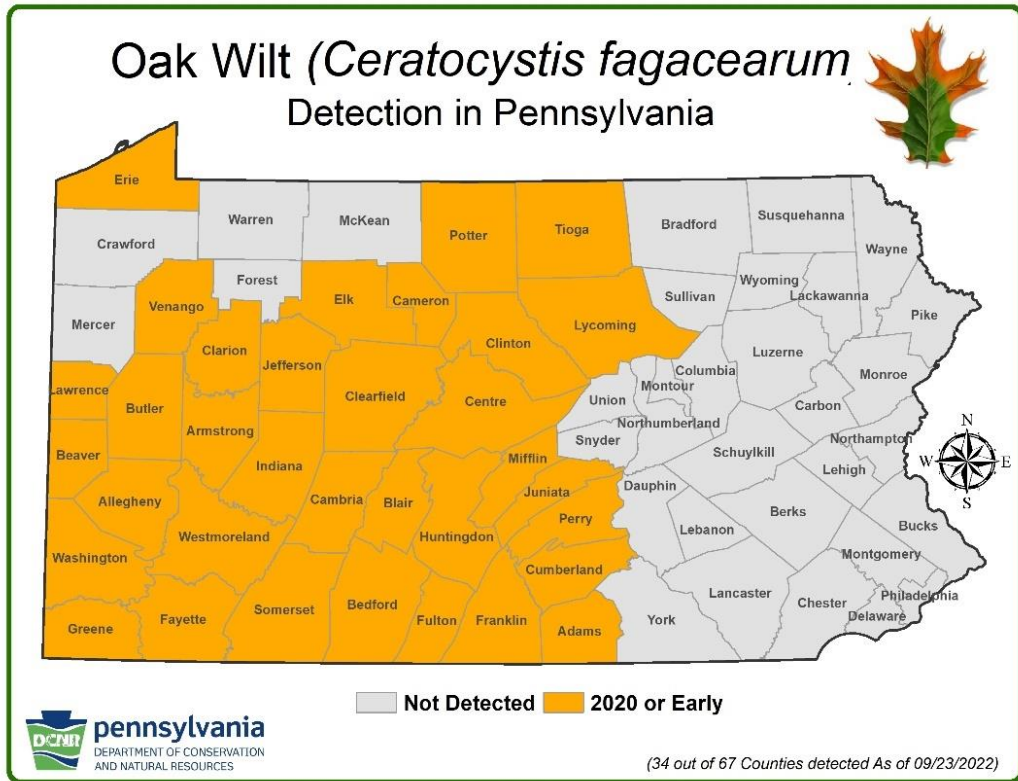


Figure 12. County map of Pennsylvania showing year counties recorded positive for oak wilt.

### White pine

Brown spot needle blight (*Lecanosticta acicola*) was the primary pathogen of white pine, being more severe in the north part of the state in 2022. It hasn't been as severe as in recent years, however over 9500 acres was mapped in 2022. Remeasurements of permanent white pine monitoring plots were done and two more monitoring plots were established in the Southern Area. In stands where white pine needle damage (WPND) was severe over the last few years, the trees are thin in the crown but have recovered somewhat. However, these stands won't be able to withstand many more severe outbreaks.

Mortality of white pine in the Northern Area has stabilized from last year where dry conditions over the past couple of years most likely took a final toll on them along after enduring poor sites on steep slopes and consecutive years of WPND and ongoing *Caliciopsis* canker issues. In 2022, possible spongy moth damage was a causal factor of mortality in small understory white pines on Gamelands 75 in Lycoming County, which was hit hard with defoliation for 2 years in a row coupled with *Caliciopsis* canker as contributors of eastern white pine understory mortality.

## Beech leaf disease

Beech leaf disease (BLD) has been confirmed in 65 of 67 counties in the state with 26 new counties added in 2022 (Figure 13). 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 14). Six additional permanent beech monitoring plots were set up in 2020 (remeasured in 2022), with 13 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. Understory beech are succumbing to this disease complex in areas where it has been present for at least 2 years and is particularly swift in areas where beech bark disease is already present.

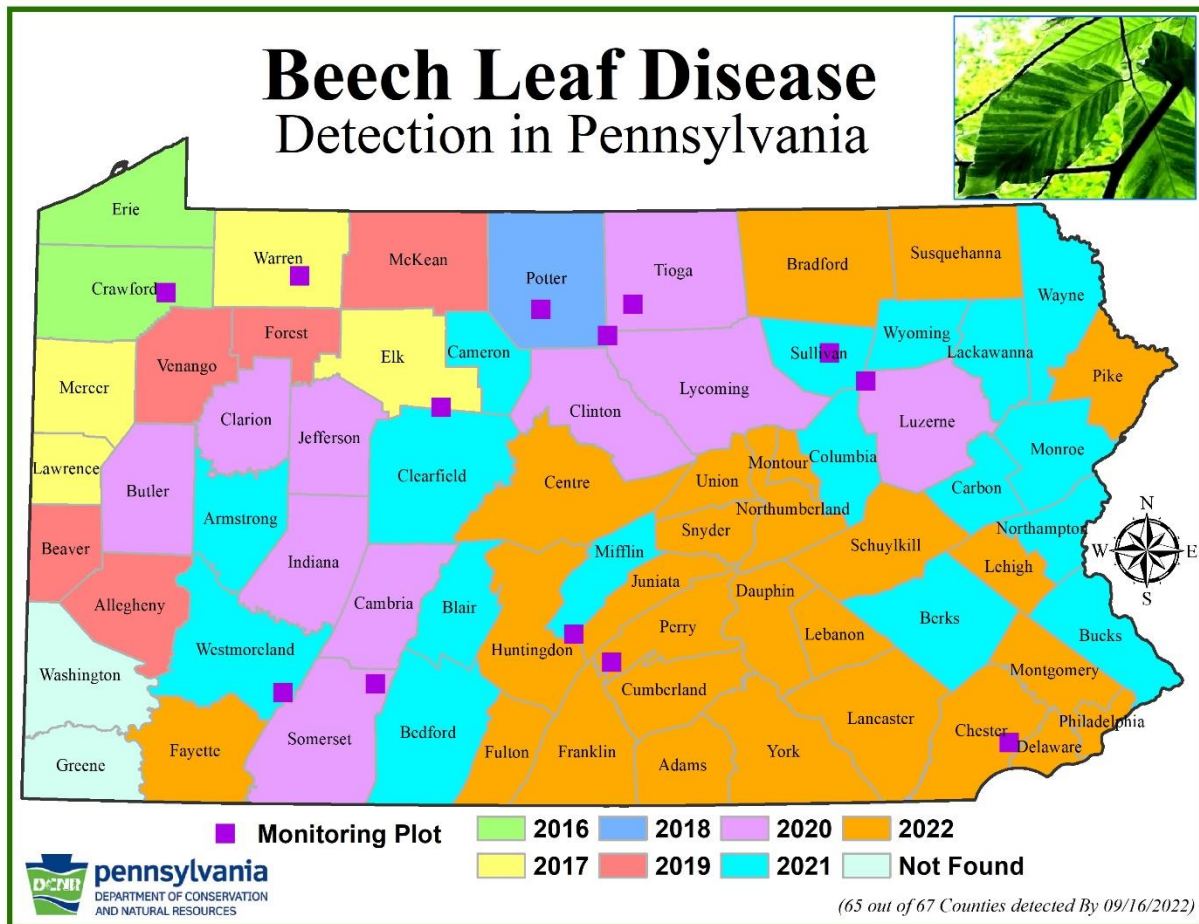


Figure 13. County map of Pennsylvania showing year counties recorded positive for BLD and 2022 monitoring Plot.



Figure 14. Beech leaf disease striping

### Other Oak Mortality Issues

More oak decline areas are manifesting across the state. Mostly white and chestnut oak but some red oak as well. Given what is known about oak decline, most likely a variety of past stressors are contributing to the decline. Late season frosts occurred throughout the state in 2020 and 2021 and prior to that, heavy anthracnose occurred in 2018 and 2019 and caused decline and mortality in stands of oak (chestnut) in the state. In 2021 and 2022, moderate to severe spongy moth defoliation along with drought issues occurred which could have served as the final “nail in the coffin”. Most likely other late season frosts and excessive rain followed by late season droughts occurred over the past decade, not limited to the years mentioned above. Late winter of 2013 and early 2014 was unusually cold leading to a polar vortex event in early 2014 resulting in temperatures 20 to 30° F below average. Record low temperatures occurred into March of 2014. While not a sole factor is responsible for this decline and mortality, it is quite safe to say that the culmination of the factors (mentioned above) over time are what is resulting as mortality in these stands that are already predisposed to oak decline (tree age, shallow rocky soils) in 2021 and 2022.

### Spotted Lanternfly

Spotted lanternfly is spreading quickly and now found in 45 of the 67 counties in PA. Our current research effort for this invasive species focused on egg mass distribution and adult sex ratio and mortality, with 2 journal articles published in 2022. The Pennsylvania Department of Agriculture is the main hub managing this pest and more information can be found at their website, ([http://www.agriculture.pa.gov/protect/plantindustry/spotted\\_lanternfly/Pages/default.aspx](http://www.agriculture.pa.gov/protect/plantindustry/spotted_lanternfly/Pages/default.aspx)).

### Northern Walking Stick

Northern walkingstick population crashed at our Bedford County site with egg density decreased from 184 eggs/m<sup>2</sup> in 2019 to <1 egg/m<sup>2</sup> in 2022. No defoliation on oaks and cherries were observed.

### Walnut twig beetle

Working with Pennsylvania Department of Agriculture (PDA), we resumed walnut twig beetle trapping at 4 sites in Bucks and Chester counties. No beetles were recovered.

## Abiotic Conditions

In the Northern Area, drought was present for most of the growing season exacerbating the oak wilt activity and spread in Potter and Tioga Counties (Figure 15). Through May-July, the precipitation levels were 26-50% below average with August being 11-25% below level (Figure 16).

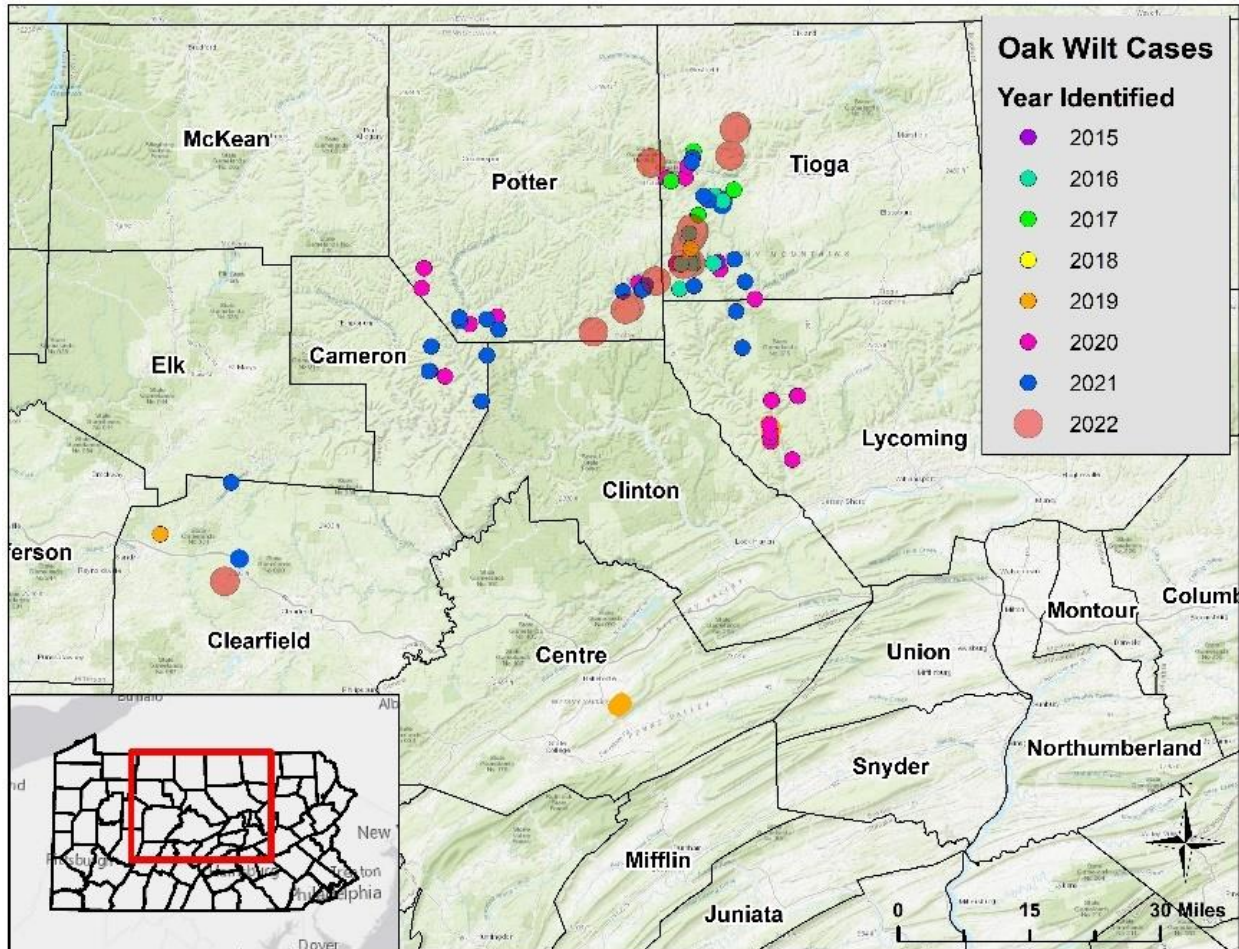


Figure 15. Oak wilt locations identified by year in north central Pennsylvania.

The drier spring helped keep WPND limited in its severity, however still some outbreaks occurring in the Northern Area. It is thought that since drought was prevalent across much of the state throughout the growing season, more oak decline and mortality will manifest over the next few years, especially with past growing seasons' droughts and spongy moth defoliation severity.

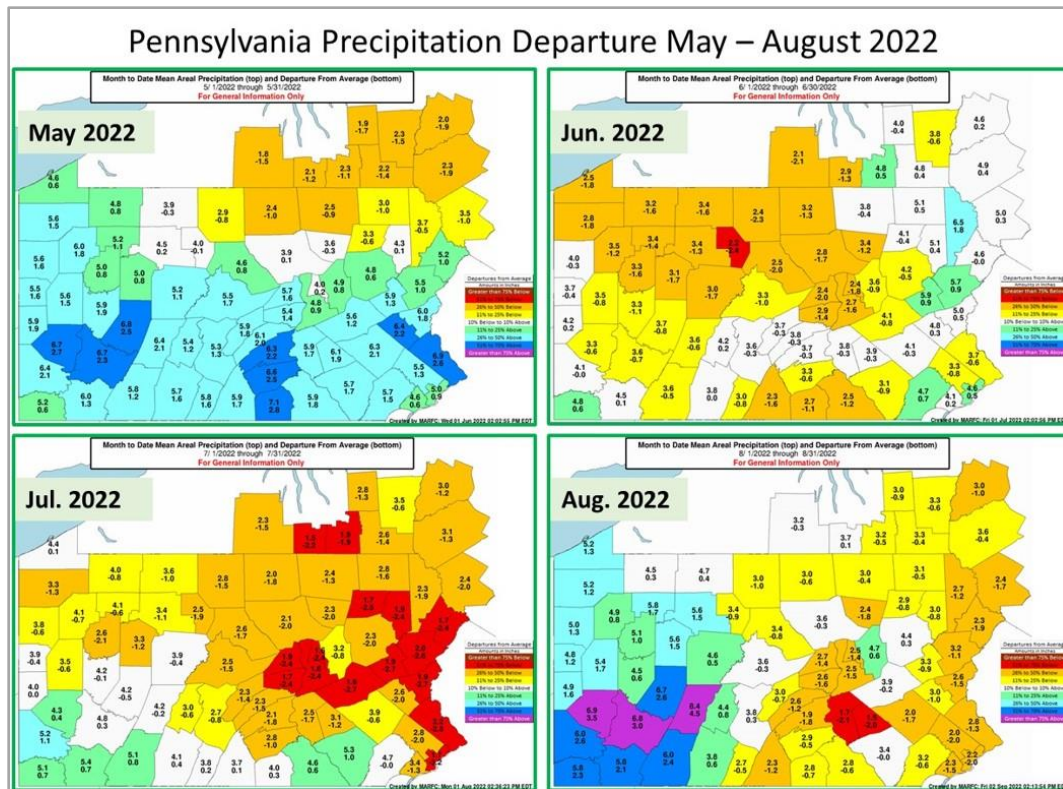


Figure 16. Map of Pennsylvania precipitation departure May – August 2022.

The drought also appeared to be a contributing factor to the decline and mortality of oak species in the western and central part of the state. In June and July there was a 26-50% deviation in the average precipitation levels in the western part of the state where white oak decline and mortality was being reported. In July and August there was the percent deviation for the average in the central part of the state where white and red oak mortality was being reported (refer to Precipitation Departure Map). For most of the growing season, it was abnormally dry across the state and more mortality in oak and white pine is to be expected given the various biotic stressors that are impacting these species already (Figure 17).

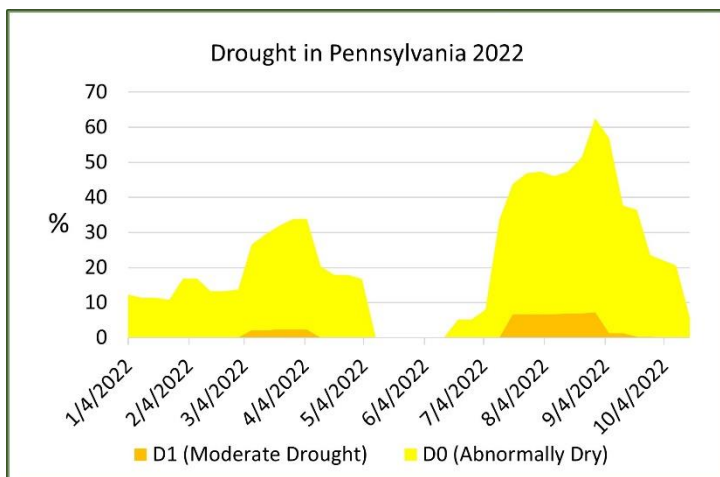


Figure 17. Map of Drought in Pennsylvania 2022.