

1. Indiana's Forest Resources

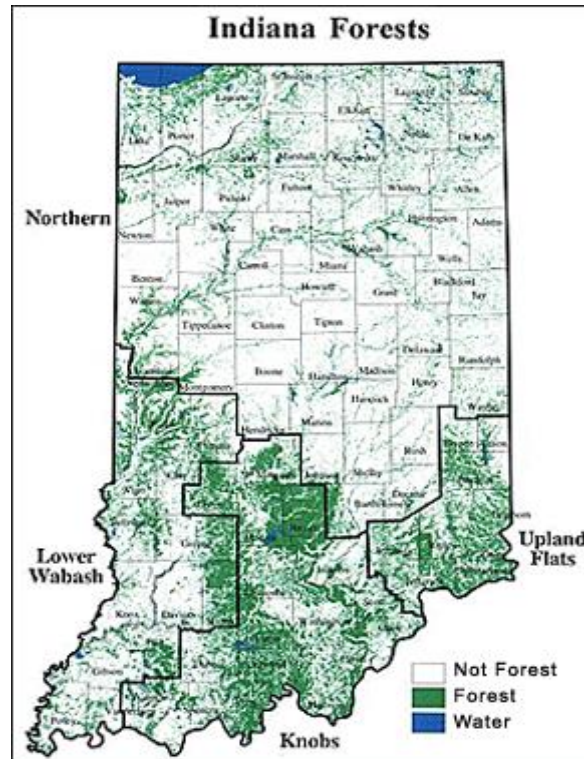


Figure 1. Distribution of Indiana's Forests

1.1 Forest Area, Types, Species

Reflecting the effect of past glaciations, forests exist in large consolidated blocks chiefly in the hilly southern part of the state. In the northern two-thirds of the state, forests generally occupy scattered woodlots, wetlands, and riparian corridors (figure 1)

Currently, Indiana houses 4,774,495 acres of forest land. Forested area has decreased by about 105,505 acres (2.1 percent) since 2014. Timberland accounts for 4,604,064 acres (96.4 percent) of forest land, while 172,431 acres (3.6 percent) of forest land is reserved or unproductive.

Eighty-three (83) percent, or 3,973,561 acres of forest land, is privately owned. The state and local government own 8.4 percent or 401,995 acres while the federal government owns roughly 8.3 percent or 398,939 acres. A little over 3.6 percent or 170,431 acres of forest land is considered reserved.

Indiana has surprisingly diverse forests, encompassing northern maple / beech / birch types to southern bald cypress swamps. The land is dominated by the oak-hickory type in south-central Indiana. The 2019 FIA survey period identified 97 different tree species growing in Indiana forests. Hardwoods are the dominant species in Indiana. The oak/hickory group alone occupies 72

percent or 3,452,538 acres of forest land, the bulk of which resides in the white oak/red oak/hickory forest type.

Forest land consists mainly of sawtimber stands at 3,908,739 acres or 82 percent, pole timber stands at 580,294 acres or 12 percent, seedling-sapling stands at 261,600 acres or 5 percent, and nonstocked at 23,862 or less than 1 percent. Indicative of a maturing (aging) forest, white and red oak/hickory is found primarily in the sawtimber stand-size class.

The sugar maple (*Acer saccharum*) is the most numerous tree in Indiana with an estimated 346 million individuals; followed by American beech, sassafras, American elm, and red maple for number of trees >1 inch at root collar on forest land. Interestingly, sugar maple is not the most voluminous species in the state that distinction belongs to the state tree, yellow poplar, a.k.a. the tulip tree (*Liriodendron tulipifera*) with a net volume of nearly 1.32 billion cubic feet. These yellow poplars also store approximately 24.65 million tons of woody biomass in their tissues.

Ash species group followed by yellow-poplar show the highest mortality (by number of trees) in Indiana for the 2019 forest inventory, and by volume white ash, green ash, yellow-poplar are the top three followed by black oak, slippery elm, sugar maple, white oak and black cherry. Annual mortality is 76,257,975 trees and 166.8 million cubic feet.

Source: Forest Inventory EVALIDator web-application Version 1.8.0.01. <https://apps.fs.usda.gov/Evalidator/evalidator.jsp>
Source: https://public.tableau.com/views/FIA_OneClick_V1_2/Factsheet?%3AshowVizHome=no

1.2 Volume – Growth & Mortality

Net volume (10.8 billion cubic feet) experienced an increase of about 2.9 percent since 2014. Yellow poplar and sugar maple were the top two individual tree species by volume estimates, with over 1.2 and 0.97 billion cubic feet, respectively. White oak, black oak, and American sycamore rounded out the top five with over 0.44 billion cubic feet. Annual net volume growth (174.9 million ft³) was led by yellow-poplar and sugar maple (28.8, 22.6 million cubic feet). White ash continues to be number one in annual mortality – 37.3 million cubic feet. Green ash, yellow poplar, black oak, and slippery elm, respectively, round out the top five in annual mortality (17.8, 13.6, 8.3, 6.2 million cubic feet). Total annual mortality of sound bole volume is 166.8 million cubic feet.

Source: Forest Inventory EVALIDator web-application Version 1.8.0.01. <https://apps.fs.usda.gov/Evalidator/evalidator.jsp>

1.3 Forest Product Industry

The Indiana forest products industry is the sixth-largest manufacturing industry in the state. Indiana ranks ninth nationally in total lumber production and third in hardwood lumber production. Indiana forests contribute over \$10 billion annually (2018) to Indiana's economy. In 2013, Indiana's primary wood-using industry included 130 sawmills, five veneer mills and two mill producing other products. Direct employment within the industry accounted for over 70,000 (2016) people and by indirect and induced effect, the industry supports around 60,000 jobs. Forest-based manufacturing provided \$5.5 billion (directly and indirectly) in value-added, \$8.7 billion in value of shipments, and a payroll of \$2.6 billion to Indiana's economy in 2016. Between 2008 and 2013, industrial round wood production increased by 8.3 percent to 69.1 million cubic feet. Saw logs accounted for 92 percent of the total harvest, with other minor products primarily veneer logs, pulpwood, handles, and cooperage making up the rest.

More information on Indiana Timber Industry:

1. 2013, Resource Update FS-116 https://www.fs.fed.us/nrs/pubs/ru/ru_fs116.pdf
2. Indiana Hardwood Assessment <https://www.in.gov/isda/files/IN%20Hardwood%20Assessment%20Final.pdf>

1.4 Maple Syrup

Maple syrup is a product of Indiana's forests. In 2020, there were 200 maple syrup producers with 29 counties having at least one producer. Most are found in northern half of the state. Of those, 78 responded to a survey with 53 indicating a total production of 24,139 gallons of maple syrup. This was up from 19,168 gallons in 2019. A total of 53,152 taps produced an estimated 1,079,013 gallons of sugar water with an average 44.7 gallons to get one gallon of maple syrup. The 2020 retail prices for gallon, quart and pint are \$43.72, \$13.46 and \$8.39, respectively. Average dollar return per tap is \$24.45 compared to \$14.42 in 2019. The estimated statewide income is \$1,055,313 and can approach \$1.3M accounting for producer consumption, product given away and product not reported.

Source: https://www.in.gov/dnr/forestry/files/fo-maple_syrup_report_2020.pdf

2. State Forest Health Issues – An Overview

The **2020 growing season's forest health problems and concerns** began again this year like 2019 with a wet late April and May to June that brought on leaf disease such as anthracnose. However, not like 2019, the gypsy moth population across northern Indiana was not impacted by the wet weather bringing on the fungus *Entomophaga maimaiga* and virus NPV to kill gypsy moth caterpillars. Emerald ash borer (EAB) mortality travelled to the Illinois border in northern west central Indiana. EAB continued to increase ash mortality in southwest Indiana which is expected to peak by 2022.

Oak shot hole leaf miner combined with frost/freeze and anthracnose was the new and first-time recorded occurrence of this pest damaging the forest in Indiana. The damage was defoliation and occurred in south central Indiana. The area of defoliation was concentrated in Brown, Bartholomew, Jackson, Lawrence, Monroe and Morgan counties. It also occurred in Crawford, Harrison, Martin, Orange and Owen counties. This is also the area of widespread chestnut oak mortality during the past four years and experienced the 2012 drought.

Sudden oak death, *Phytophthora ramorum*, was not detected in nursery surveys in 2020. The detection in 2019 on rhododendrons distributed to garden centers across the state is still a concern and survey of water sources in forests is planned for 2021. This disease is not present in Indiana.

Surveys for thousand cankers disease of black walnut have not detected walnut twig beetle or an infected tree in 2020. Walnut twig beetle was trapped at two sawmills and two plantations prior to 2019 but not detected since at these locations. This disease is not present in Indiana.

These forest pests continue to be the **recurring forest health issues** plus oak wilt and the aging hardwood forests.

Future forest pests of concern include the exotic pests, Asian longhorned beetle, hemlock woolly adelgid, beech bark disease, beech leaf disease, gold spotted oak borer, other *Agilus* spp., spotted lantern fly, and laurel (red bay) wilt.

Asian longhorned beetle adult was captured inside a factory in Porter county and believed to be an interception from shipping material and not from a local infestation as surveys at the location have not detected infested trees.

Laurel wilt may be present in the state based on reports of wilting sassafras trees. Surveys for redbay ambrosia beetle and testing for the wilt fungus have not detected either one.

Survey of American beech for beech leaf disease in 2020 did not detect it.

Invasive plants are affecting Indiana forest regeneration and biodiversity. Plants of concern are kudzu, *Pueraria montana*, tree of heaven, *Ailanthus altissima*, bush honeysuckle, *Lonicera spp.*, Japanese stilt grass, *Microstegium vimineum*, garlic mustard, *Alliaria petiolate*, and others.

The kudzu eradication program continues its efforts and to date 208 sites in 43 counties totaling 227.68 acres are confirmed. This is an increase of 3 sites and 3.65 acres. The goal is to move kudzu to the Ohio River and eventually out of Indiana.

The Division of Entomology and Plant Pathology implemented the Terrestrial Plant Rule (312-IAC-18-3-25) in 2020 prohibiting and restricting 44 terrestrial invasive plants. With the Aquatic Plant Rule (312-IAC-18-3-23), 74 invasive plants are prohibited or restricted from sale or position.

3. First time occurrence impacting Indiana Forests

3.1 Oak Shot Hole Leaf Miner – *Japanagromyza viridula* syn *Agromyza viridula*

The 2020 spring – late April and early May – had cool temperatures average 50F and >1.0” of rain. This weather conditions are ideal for the spread and infection of young new leaves with anthracnose. In addition, freeze events also at that time damaged newly opening buds ‘burning’ the new leaves (turns the tissue black). And the first occurrence of widespread defoliation from oak shot hole leaf miner occurred.

Oak shot hole leaf miner is a fly. The female punctures the opening buds with her ovipositor and feeds on the fluids that emerge from the wound. As the leaf continues to grow, the wound becomes a circular hole creating a shot hole appearance to the leaf (figure 2).



Figure 2. Shot hole leaf minor damage on black oak leaves.

Later the female lays an egg in the edge of the leaf. A maggot hatches and feeds (mine) between the upper and lower leaf surface. Eventually, the mined leaf area turns black in color and is similar in appearance to anthracnose infected leaf tissue. This damage results in defoliation to the tree as leaves do not develop to normal shape and size.

The Hoosier National Forest reported this problem to black oak in the Brownstown Ranger District in Jackson County in late June. Viewing the trees from the ground found that approximately 50%

of the leaves had damage that also looked like anthracnose. In addition to black oak, damage also occurred to red, scarlet and white oak.



Figure 3 and 4: July 2020 photo showing forest defoliation by the off green color from shot hole leaf miner, anthracnose and frost/freeze over Brown County State Park and Yellowwood State Forest area (left) . Areas of shot hole leaf miner defoliation mapped during 2020 aerial survey in south central Indiana (right).

Aerial survey in July mapped the forest defoliation from Owen and Morgan counties south to interstate 64 that totaled 76,992 acres (figure 4). The majority of the defoliation occurred in the area including Brown County State Park, Yellowwood and Morgan Monroe State Forests and the Brownstown district of the Hoosier National Forest (figure 3). Additional defoliation was mapped in Martin and Orange Counties that included Martin State Forest and Lost River District of HNF. South of Interstate 64, a smaller amount of defoliation was detected in Harrison-Crawford State Forest and Tell City District of the Hoosier National Forest. The total forest acres impacted is greater than just the area mapped by aerial survey as foresters measuring forest inventory plots reported shot hole symptoms in other southern Indiana counties

4. Exotic Insect Pests of Indiana Forests

Gypsy moth, thousand cankers disease of black walnut, chestnut oak mortality and emerald ash borer continue to dominate the monitoring and management activities. Monitoring activities are adding sudden oak death, laurel wilt (sassafras mortality), beech leaf disease, hemlock woolly adelgid and spotted lantern fly to forest health survey activity in 2021.

4.1 Gypsy Moth – *Lymantria dispar*

The 2020 Cooperative Gypsy Moth Survey completed its 33rd year of the statewide survey. The survey is part of the Slow-the-Spread (STS) Program and uses the STS protocol for its design and operation dividing the state into three zones (figure 5): the STS Evaluation Zone, the STS Action Zone, and the State Area. The survey design used fixed 8K & 5K, fixed 3K & 2K and fixed 3k survey grid points for the three zones, respectively. In the state area, 21 counties were surveyed partially or not at all for economic reasons and no trap catches in prior years. Across all zones, the survey deployed 10,071 traps all referenced by GPS.

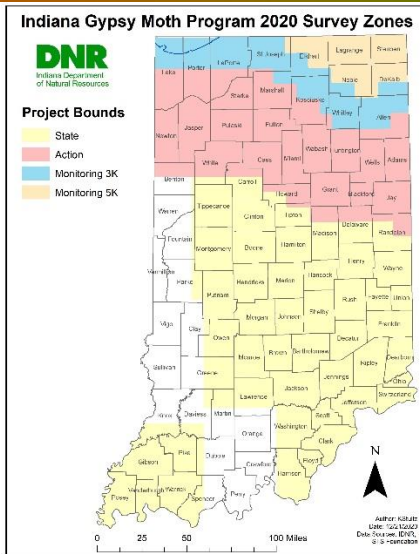


Figure 5: Gypsy moth survey zones - yellow state zone, pink slow the spread action zone, blue slow the spread monitoring zone 5k, tan slow the spread monitoring zone 8k

The survey detected 35,075 moths from 51 counties (34 in the STS Zones and 17 in the state Zone) ranging from 1 to 6,345 moths per county. This is almost double the 2019 catch of 17,935 moths, and is similar to the catch in 2016, 2017, and 2018 (figure 6). The moths were smaller in 2020. The increase catch and smaller moths is believed to be from epidemic gypsy moth populations in Michigan,

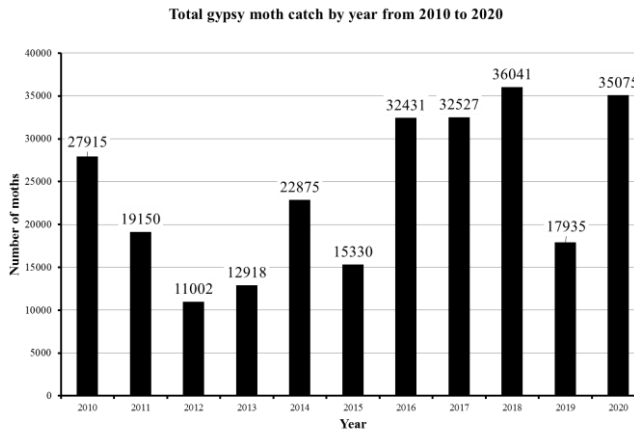


Figure 6: Graph showing number of male gypsy moths caught by year from 2010 to 2020.

As in prior years, the majority of the moth catch was in the Evaluation Zone (figures 5,7,8), which includes the quarantined counties Allen, DeKalb, Elkhart, LaGrange, LaPorte, Noble, Porter, St. Joseph and Steuben detecting 27,076 of 35,075 moths (77.19%). The Action Zone detected 7,837 of 35,075 (22.34%). The majority of the Action Zone moth catch occurred in the northern and eastern parts adjacent to the Evaluation Zone. The State Area detected 162 of 35,075 of the moths (0.46%).

Since the survey began in 1972, a total of 634,442 moths have been caught in 90 of the 92 counties. Gypsy moth has not been detected in Dubois or Sullivan County since surveys began in 1972.

2020 Indiana Gypsy Moth Positive Traps

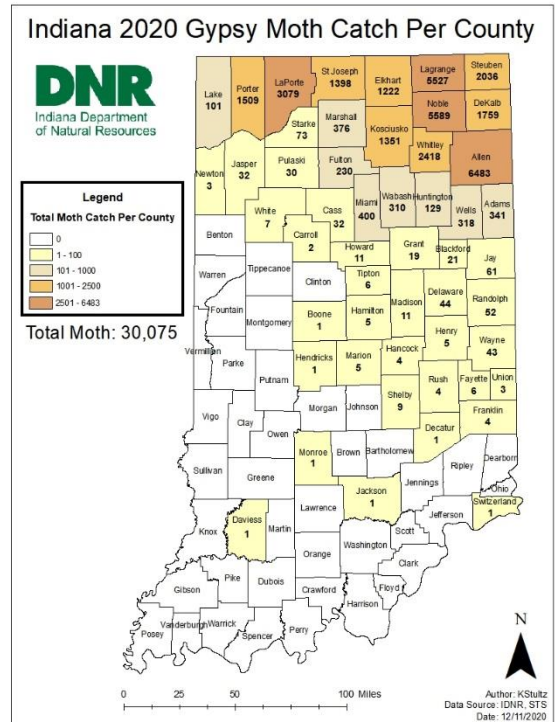
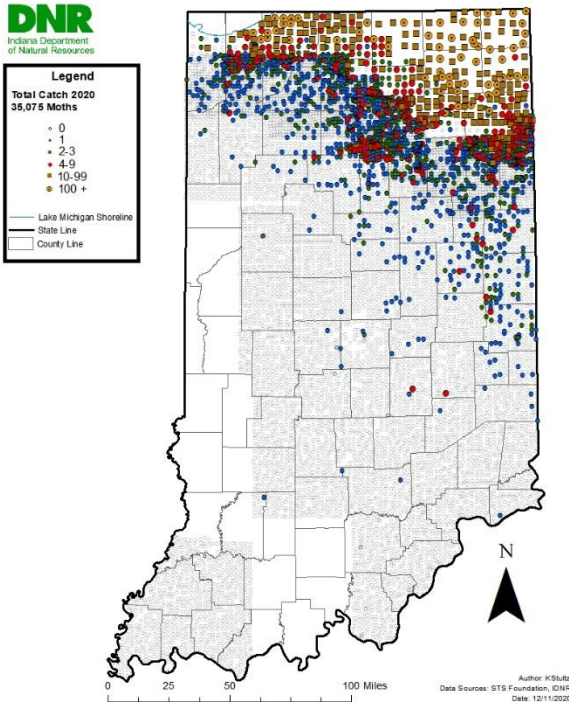


Figure 7 and 8: Map showing 2020 Gypsy Moth trap locations by range of catch from 0 to 100+ in each trap (left). Map: 2020 Gypsy Moth catch in each county. Total moth catch for state – 35,075 (right)

Defoliation 2020

Two locations had noticeable defoliation in 2020. Woods in Maples area in Allen county and one farmhouse in Whitley county for a total of 35 acres. There was no defoliation in 2019 and the 2018 defoliated areas did not have defoliation in 2020.

Treatments 2020:

Btk (*Bacillus thuringiensis kurstaki*):

Treatment using Btk was conducted on two sites in 2020 totaling 780.99 treatment acres (table 1 and figure 9) All sites were treated twice bringing to total for acres treated for all applications to 1,561.98. Application cost was \$39.03 per acre per application.

Mating Disruption:

Two sites totaling 4,384 treated acres were treated once with Splat GM Organic at 6 gram/acre rate (table 2 and figure 9). Mating disruption application cost was \$6.97 per acre (\$30,556.48 total cost of application)

Eradication: - Richmond:

In 2016, detection trapping caught two moths in one trap. The 2017 delimit trapping caught 15 moths in one trap. The 2018 delimit trapping caught 17 moths in four traps (10, 5, 1, 1 moths per trap). Since the site is the headwater area of the Whitewater River watershed and is in the middle of the state, eradication treatment applied 2 applications of Btk in 2019. The 2019 delimit trapping caught one moth in one trap indicating a successful treatment. The 2020 delimit trapping caught seven moths in six traps in and adjacent to the treatment site and no detection of eggmasses. The site will be delimited in 2021 to decide if another eradication treatment is needed.

Eradication: - Purdue:

In 2014, an eradication began with treatment on the campus of Purdue University. In 2015, five moths were caught in the 2014 treatment area, but in 2016 that number jumped to forty-six prompting treatment again in 2017. In 2017, twenty-four moths were caught in eleven traps in the 2014 treatment area. In 2018, nine moths were caught in two traps at the core of the treatment area. In 2019, 5 moths were caught in one trap in the treatment area and traps placed on the center core trees of the infestation did not capture moths. That one trap was near construction trailers for a new residence hall in the treatment area. Thus, the five moths are believed to have originated from contractors bringing life stages to the treatment area. No moths were trapped in the area in 2020 and the 2021 delimit will hopefully confirm eradication.

Table 1: 2020 STS Btk treatment sites.

COUNTY	SITE NAME	Acres	Total Acres Treated
Porter	Westville Btk 20	220.74	441.48
Huntington	Huntington Btk 20	560.25	1,120.50
			1,561.98

Table 2: 2020 STS Mating Disruption Treatment Sites.

COUNTY	SITE NAME	Acres	Total Acres Treated
Huntington	Huntington MD 20	3,984	3,984
Marshall	Green Twp. MD 20	400	400
			4,384

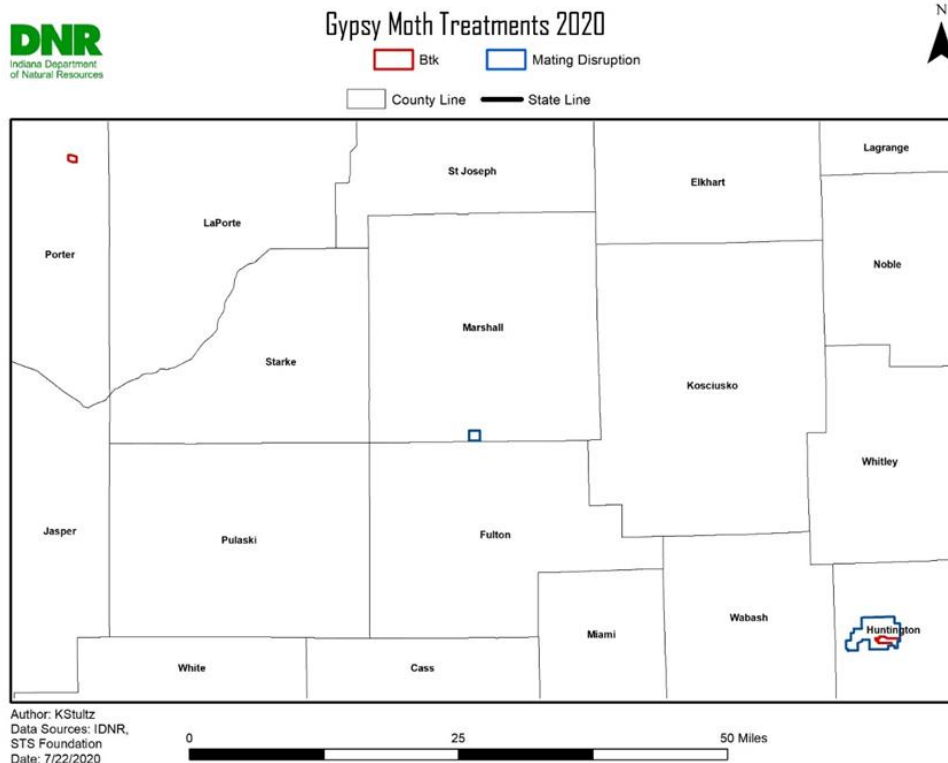


Figure 9: Map: 2020 Gypsy Moth Treatment Sites. Blue outline is Mating Disruption. Red outline is Btk.

Quarantine:

The process started in 2020 to quarantine Lake and Whitley counties (figure 10). The 10-moth line is used to consider a county for quarantine. The ten moth line map below (figure 11) shows the

historic 10-moth line for the last five years. It continues to remain fairly stationary. However, it has moved more than halfway through Whitley County which is a criterion to quarantine a county. Adding Lake County will close a ‘gap’ in the quarantine area with Illinois. The process is expected to be completed in 2021. The last year a county was added to the quarantine was 2010.

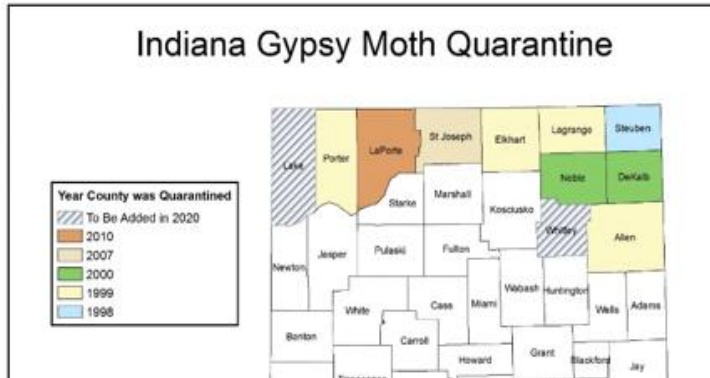


Figure 10: Map Gypsy Moth quarantined counties through 2020 showing year initially quarantined.

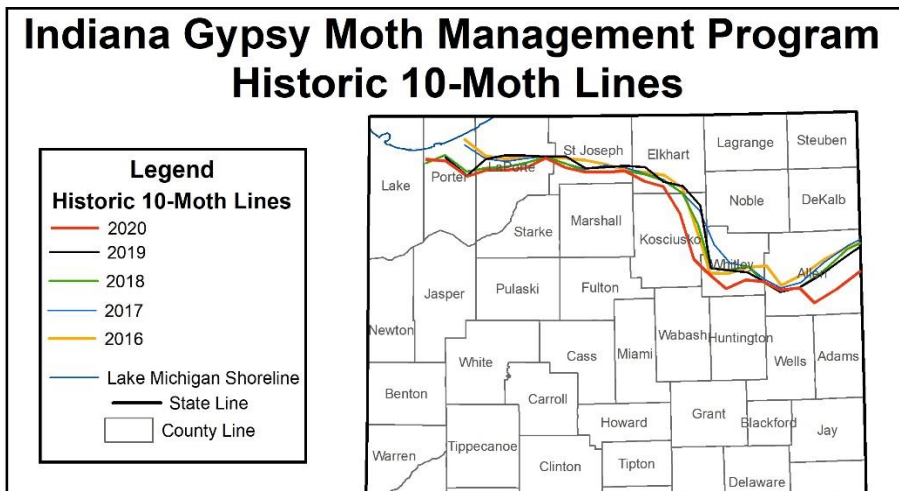


Figure 11: Map: Ten moth line from 2016 to 2020. Line means an average of ten moths caught per trap in the area of the line.

Spread Rate:

Table 3: Gypsy moth spread rate for 2020 and 3, 10, and 20 year average in kilometers and miles.

Unit	2020	3 Yr	10 Yr	20 Yr
Kilometers	8.42	2.92	0.33	-0.86
Miles	5.23	1.18	0.21	-0.53

For 2020, the three-year average spread rate (table 3) is 1.81 miles per year and the annual spread rate is 5.23 miles per year. This is well below the target of 6 mi/year spread rate.

4.2 Emerald Ash Borer - *Agrilus planipennis* Fairmaire

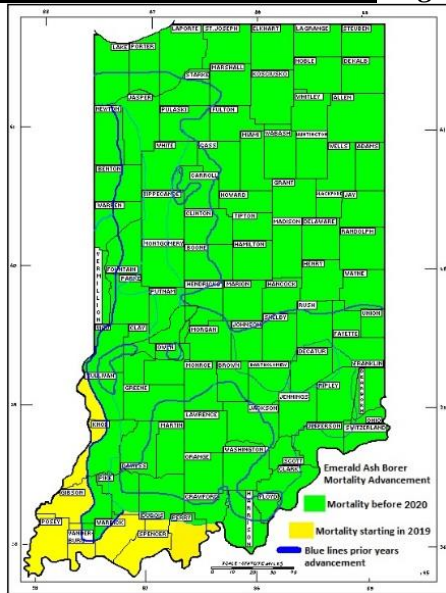


Figure 12: Emerald ash borer mortality progression through 2020 - past mortality in green and progressing mortality in yellow.

Emerald Ash Borer (EAB) was detected in all 92 counties by 2017. In 2020, the leading edge of the EAB killing wave completed its movement to the Illinois border north of Vermillion to Lake county. The 2020 aerial survey detected EAB mortality in 326 forested acres in that area bringing the total forested acres with mortality to 169,745 since 2009. This total is only through aerial survey mapping the advancing front of mortality. Adding the urban forest will also increase that total acres.

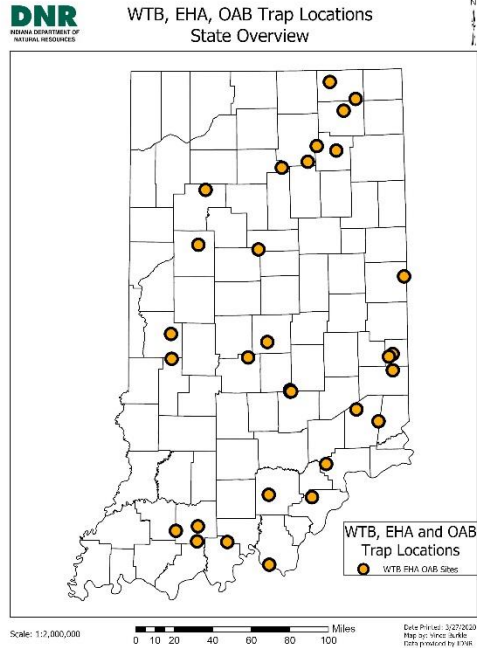
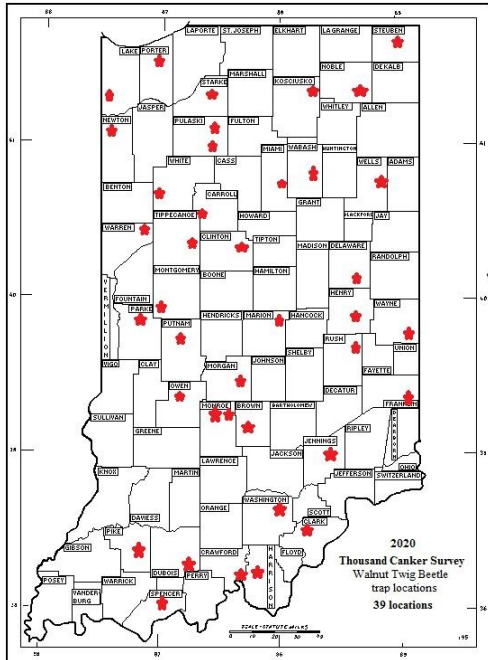
4.3 Thousand Canker Disease – *Pityophthorus juglandis* & *Geosmithia morbida*



Photo: Walnut Twig Beetle collected during 2014 survey. Photo by Bobby Brown USDA.

The 2020 walnut twig beetle (WTB) (photo) survey consisted of 82 Lindgren funnel traps at 29 high risk sites (sawmills and veneer mills) and 38 plantations or woods (figure 13 & 14). Traps were deployed mid to late April and were removed in early October.

Over 800 samples collected and no WTB was detected through November 2020.



Figures 13 and 14: Map showing location of walnut twig beetle traps in high risk sites (left). 2020 walnut twig beetle trap locations in plantations and woods (right).

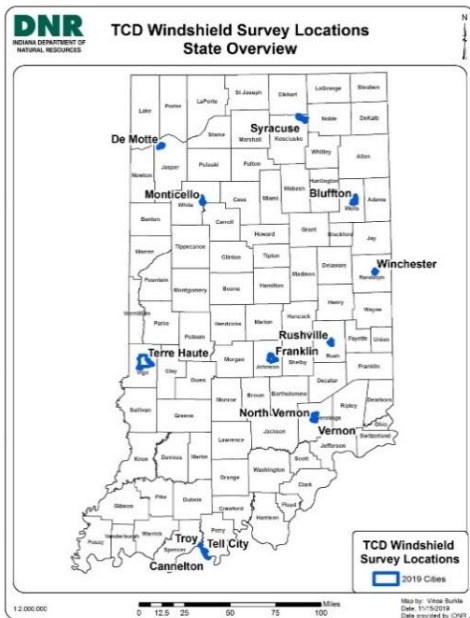


Figure 15: 2020 Thousand Cankers Disease Windshield Survey Cities

The Windshield Survey for black walnut trees was conducted in 10 cities in 2020. Surveyed were Franklin, Lafayette, Nappanee, New Haven, Perry Township Marion County, Scottsburg, Terre Haute, Vincennes, Wakarusa, and Winamac. A total of 1,441 trees were surveyed at 695 locations, in the ten cities with 4 listed as suspect for future evaluation. Suspect trees from prior year survey are not showing progressive symptoms. Since this survey began in 2012, 10,570 trees have been evaluated in 108 municipalities.

Gypsy moth trap tenders also collected data on the location and condition of walnut trees near gypsy moth traps. They identified 375 trees and indicated 11 trees with dieback or decline. Since 2011, trap tenders have collected data on 9,308 walnut trees.

From two beetles in 2014, four beetles in 2015 and one beetle in 2016 at the saw mill in Franklin County, the sawmill has been free of walnut twig beetle for 3 years, 2017, 2018 and 2019; and possibly 2020 for a fourth year once sample screening is complete.

The veneer mill in Johnson county was free of Walnut Twig Beetle for 3 years - 2016, 2017, and 2018. One beetle was detected in 2019. The 2020 survey results are not available but is hoped that no beetles are detected.

The Black Walnut Plantation on Yellowwood State Forest where *Geosmithia morbida* was detected on the weevil *Stenomimus pallida* and served as a research site continues to show NO symptomatic trees and no walnut twig beetle detected by traps or trap trees.

The 2018 trap tree survey locations in Crawford and Jennings detected WTB at each location. Delimit survey of each location in 2019 did not detect WTB. The 2020 delimit survey has not detected WTB however sample screening is ongoing and expected to be complete in early 2021. Trees in these plantations do not show symptoms of TCD.

To date, Thousand Cankers Disease of Black Walnut (TCD) has NOT BEEN DETECTED AND CONFIRMED from a walnut tree in Indiana. There is NO mortality of black walnut trees from TCD occurring in Indiana.

5. Other Exotic Insect Pests of Concern

5.1 Asian Long-horned Beetle (ALB) - *Anoplophora glabripennis*

One beetle was collected inside one industrial building in Porter county and confirmed by USDA. It is believed that the beetle came in on pallets that carried items from China. Surveys around the facility have not detected infested trees. Traps were also placed at and around the location and have not detected another beetle. This is considered an interception and not an infestation. Surveys will continue in the future.

No trapping survey conducted in 2020. No reports from the public, arborists, foresters or other natural resource personnel were received. ALB does not occur in Indiana, but there is concern for introduction into southeastern Indiana from the Bethel, Ohio infestation by movement of firewood.

5.2 Hemlock Woolley Adelgid - *Adelges tsugae*

Hemlock Woolly Adelgid (HWA) was detected in one site in LaPorte County in 2012. Survey of that site and surrounding area since 2012 has not detect HWA. Survey of native eastern hemlock forest locations scattered across Indiana continues and HWA has not been detected and has not been detected in any landscape, nursery and retail locations.

5.3 Spotted Lanternfly – *Lycorma delicatula*



Figure 16 and 17: Spotted Lanternfly 4th instar nymphs. Photo by Stephen Ausmus (left) Spotted lanternfly adult. Photo by Lawrence Barringer, Pennsylvania Department of Agriculture (right).

Spotted lanternfly is an invasive species native to China, Bangladesh and Vietnam and was detected in Berks county Pennsylvania in 2014. It is a colorful planthopper that sucks sap from plants excreting a honey dew that is sticky and turns black with the growth of sooty mold. Besides the nuisance of insect and the honey dew dropping from infest trees, this sap feeding stresses the plant and can lead to dieback.

It feeds on more than 70 plant species and has a strong preference for grapevines, maples, black walnut, birch and willow. Tree of Heaven, an invasive tree, plays a role in the life cycle of spotted lanternfly.

In late October 2020, it was detected in eastern Ohio border along the Ohio River. Earlier in 2020, Pennsylvania detected it in the Pittsburgh area when infested area is in the eastern side of the state. In both detections, it was associated with rail yards indicating it is hitch hiking on trains. Another suspect carrier is semi-trailers and truck stops are a possible point of introduction especially if tree of heaven is nearby.

Also in late 2020, Maine detected spotted lanternfly egg masses on plants shipped in from Pennsylvania and Oregon found a dead adult in a shipment of planters and ceramic pots from Pennsylvania.

Spotted lanternfly has not been detected in Indiana. Surveys in 2021 will focus on rail yards and truck stops. Garden centers and nurseries are inspected each year with inspectors checking for egg masses, nymphs and adults. Tree of heaven locations will also be a focus of surveys plus public awareness to report it.

Other states with spotted lanternfly are Connecticut, Delaware, Maryland, Massachusetts, New Jersey, North Carolina, Virginia, and West Virginia.

6. Plant Pathogens of Concern

6.1 Chestnut Oak Mortality – disease complex cause to be studied

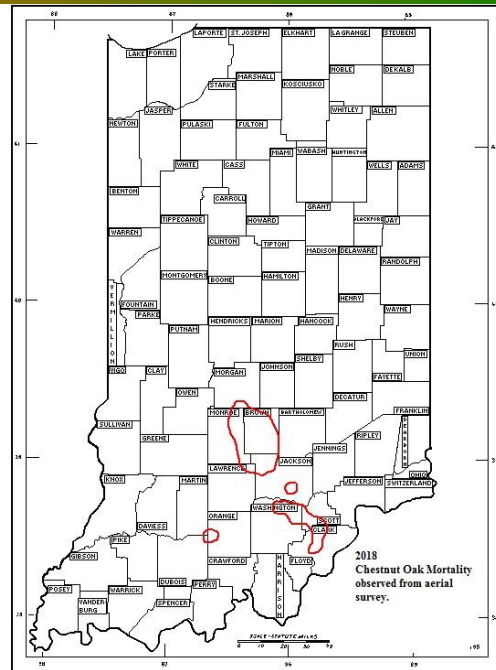
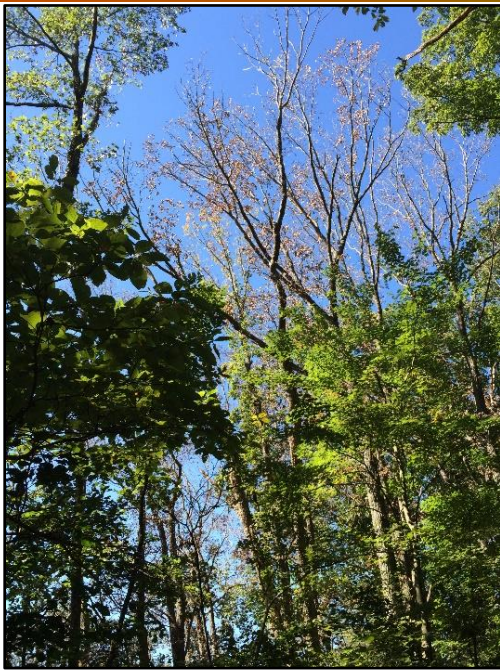


Figure 18 and 19: Chestnut oak mortality Patoka Reservoir September 2016 (left). Areas in southern Indiana with chestnut oak mortality in 2018 (right)

The forest health management plan to address chestnut oak mortality (figure 18) at Patoka Reservoir (Dubois county) has completed the environmental assessment with the decision notice expected in early 2021 and planned implementation to follow. The plan proposes to salvage mortality, suppress further mortality, regenerate the forest, and implement wildlife management in the area.

The 2020 aerial survey that included the chestnut oak mortality areas mapped in 2018 and 2019 did not map additional mortality (figure 19). This was due to the occurrence in spring 2020 of oak shot hole leaf miner and frost/freeze/anthracnose defoliation that masked any symptoms. This defoliation adds to the forest health stress that this region has experienced since 2012. With the added stress mortality is expected to develop and increase in 2021 and beyond.

Using Continuous Forest Inventory data from state forests, it has shown that chestnut oak average annual volume mortality from 2015-Bis is leading other species at 15%. Following it is white ash – 13.7%, yellow poplar - 9.2%, black oak – 8.7%, and white oak 8.4%. During this time period all oaks accounted for 41% of average annual volume mortality.

Observations of this disease initially indicated it only involves chestnut oak with *Armillaria mellea*, hypoxylon canker *Biscogniauxia atropunctata*, *Agilus bilineatus*, possibly *Phytophthora cinnamomi* as agents. However, with white oak showing 8.4% mortality, there is additional concern that the disease may be moving from chestnut oak into white oak and possibly other white oak group species.

Study of the disease is planned to begin in 2021 to determine the agent that initiates the mortality and why it is only overstory chestnut oak and if it is moving into white oak.

6.2 Oak Wilt - *Bretziella fagacearum* (formerly - *Ceratocystis fagacearum*)

Oak wilt was reconfirmed again from red oak at Southeast Purdue Ag Center in Jennings county in 2020 by Purdue Plant Diagnostic Lab (culture confirmation).

Oak wilt was reconfirmed in Brown, Parke and White counties by Purdue Plant Diagnostic Lab (culture confirmation). This was the first confirmation since 1979 for these counties (figure 20).

Tippecanoe county was reconfirmed in 2020 and was last reconfirmed in 2017.

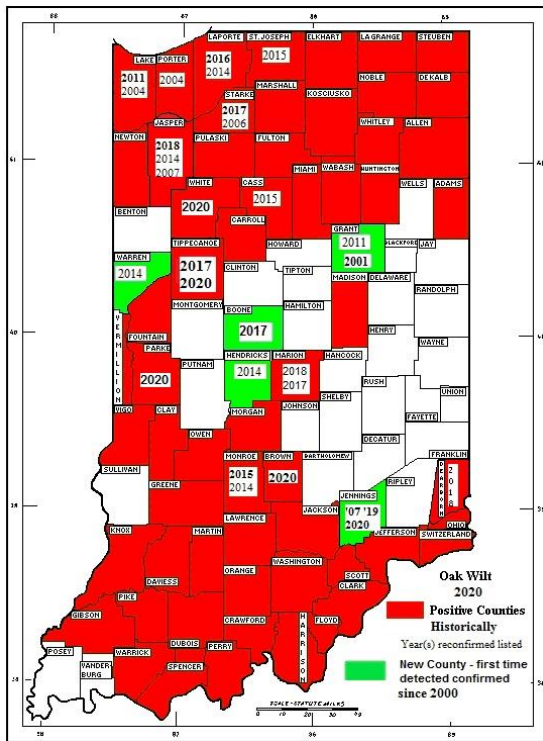


Figure 20: Counties confirmed with oak wilt. Counties in red were confirmed with oak wilt from original surveys through 1979. Green shaded counties were first time confirmation after 2000, Years in county indicate year of confirmation or reconfirmation.

There was no first time county detections in 2020. Boone County in 2017 was the last county to record a first-time confirmed occurrence. Prior to 2017, it was Hendricks and Warren counties in 2014.

Oak wilt has been detected in 65 counties and reconfirmed or first time confirmed in 19 counties since 2000 (figure 20). It is common in the woodlots of northwestern Indiana in the Kankakee River basin. Mortality occurs to red and black oak in small spots, less than one acre, consisting of sapling to saw timber size trees totaling less than 10 trees per spot, usually one to five trees.

In southern Indiana forests, oak mortality may be Oak Decline and not Oak wilt. Symptoms of the two diseases are similar and testing is needed for oak wilt confirmation versus oak decline. Oak wilt has not been detected in white oak or other white oak group trees in Indiana.

This disease was detected in northeast Ohio in 2012. The disease is expanding in Ohio and is also present in adjoining area in New York and Pennsylvania. In recent years it was also detected in New England states and Ontario, Canada.

Research in Ohio found a nematode *Litylenchus crenatae mccannii* as the cause of this disease. This is a subspecies of *Litylenchus crenatae* which is native to Japan found on *Fagus crenata*. In the U.S. there is morphological and host range differences that resulted in the subspecies designation.

District foresters surveyed 32 forests in 10 counties – Fayette, Henry, Marshall, Monroe, Noble, Owen, Parke, Perry, Putnam and Steuben,. They used the Tree Health Survey application developed by Daniel Volk of Cleveland Metroparks/Natural Resources and examined seedlings and saplings as they conducted forest inspections. Survey methods called for examining 25 seedling/saplings in the forest.

Following that guide up to 800 or more beech were examined and the survey did not detect this disease.

6.6 Beech Bark Disease - *Cryptococcus fagisuga*, *Nectria coccinea* var. *faginata*

No survey was conducted in 2020 for this disease. Foresters and arborists did not report a beech that may have this disease. Thus, this disease is not present in Indiana and is expected to first occur in northern Indiana because of its presence along Lake Michigan in the Lower Peninsula of Michigan. The concern is the possibility that infected/infested material (firewood) is brought into Indiana.

6.7 Bur Oak Blight - *Tubakia iowensis*

Bur oak blight was first detected in 2017 in Lake county. In 2018, the fungus was confirmed on swamp white oak in Allen county. No reports of the disease were received in 2019. Again, in 2020 no reports were received. However, I observed one symptomatic tree in Lake county in September and other trees observed with symptoms in 2017 did not show symptoms in 2020.

6.8 White Pine Needle Cast – *Dothistroma pini*

Yellow and tan color needles were observed on large white pine in September 2018 in Monroe county along highway 446 on the Hoosier National Forest. Purdue Plant



Figure 22: White pine with thin tree crown from needlecast

Diagnostic lab confirmed *Dothistroma pini* present in symptomatic needles. Symptoms were observed in Brown and Monroe counties in 2019 and in 2020. Thinning white pine was also reported in Orange county in 2020 (figure 22).

7. Native Insect and Disease Concerns

7.1 Jumping Oak Gall - *Neuroterus* spp.

No reports were received in 2020. It was reported in 2019 on white oak in Martin, Lawrence and Orange counties in 2019 (figure 23). Prior to that, noticeable damage occurred in 2016. Other years of damage are 2012 and 1999.



Figure 23: Jumping oak galls on underside of white oak leaf.

7.2 Forest Tent Caterpillar – *Malacosoma disstria*

There was no report of forest tent caterpillar in 2020. The last epidemic occurred in southeastern Indiana 2002 -2006 (Dearborn, Jefferson, Ohio, and Switzerland counties). Prior to that, the only other recorded epidemic was in the mid-late 1970s in south-central Indiana (Greene, Lawrence, Martin and Monroe counties).

7.3 Looper Complex – Linden looper, *Erannis tiliaria*, half winged geometer, *Phigalia titea*

Defoliation by this looper complex did not occur in 2020. The last occurrence was 2013 with very light defoliation in Washington County in Jackson-Washington State Forest.

The first looper defoliation occurred 1978-1982 across south-central Indiana. The second defoliation occurred from 2003-2004, defoliating 89,252 acres in 2003 and 131,943 in 2004 over seven south-central counties each year.

7.4 Anthracnose – *Apiognomonina* spp.

With the cool wet spring weather in late April and early May, anthracnose occurred in sycamore, oaks and other species. It was also involved in the shot hole leaf miner damage observed in southern Indiana.

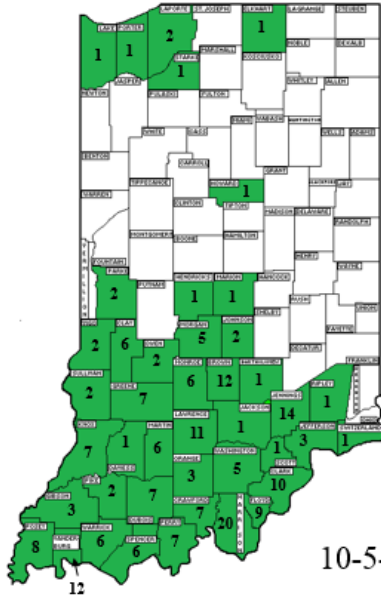
7.5 Tulip Tree Scale - *Toumeyella liriodendra*

Tulip tree scale was damaging trees starting in 2011 and peaking in 2012 in south central Indiana. Combined with the 2012 drought, yellow poplar mortality was widespread in 2012 and 2013. In 2020, I received a few reports and questions from forest owners that reported black sooty mold and trees dripping sap from tulip trees in plantations. The scale may be increasing its population and could be more prevalent in 2021.

8. Weather-Related Issues in Indiana Forests

Although tornadoes, high windstorms, and flooding occur each year, during aerial survey for Chestnut Oak Mortality 3 areas of wind damage occurred on the Hoosier National Forest on the south shore of Monroe Reservoir and included areas in the Deam Wilderness.

9. Invasive Plant Species



10-5-20 Figure 24: Counties with Kudzu and number of kudzu sites in each county.

9.1 Kudzu - *Pueraria lobata*

Kudzu, an Asian native invasive vine, is located throughout Indiana but is predominately in southern Indiana. Currently there are 208 known sites totaling 227.67 acres in 43 counties (figure 24). The majority of the sites are less than one acre. Three new sites totaling 3.65 acres were confirmed in 2020.

Treatment of kudzu by IDNR-DEPP began in 2006 and has continued annually to remove kudzu from Indiana. In 2020, herbicide applications were conducted at 55 kudzu sites in 24 counties. A total of 75.23 acres were treated by IDNR-DEPP staff and contract in 2020.

For all DNR DEPP treated sites, 91.2 percent have at least 90 percent suppression or greater. This is up from 88 percent in 2019.

(Ken Cote, Division of Entomology & Plant Pathology Personnel Communication)

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