2006 Indiana Forest Health Highlights

1. Indiana's Forest Resources

Approximately one of five acres in Indiana — 4.5 million acres — is covered in forest (Figure 1). Since 1950, forestland has increased more than 450,000 acres, and by nearly 52,500 acres between the last inventory (1998) and the current one (2003). Indiana has surprisingly diverse forests, encompassing northern maple / beech / birch types to southern bald cypress swamps. More than 85 different tree species grow in Indiana forests. Hardwoods account for 95% of the forest (Figure 2). 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.

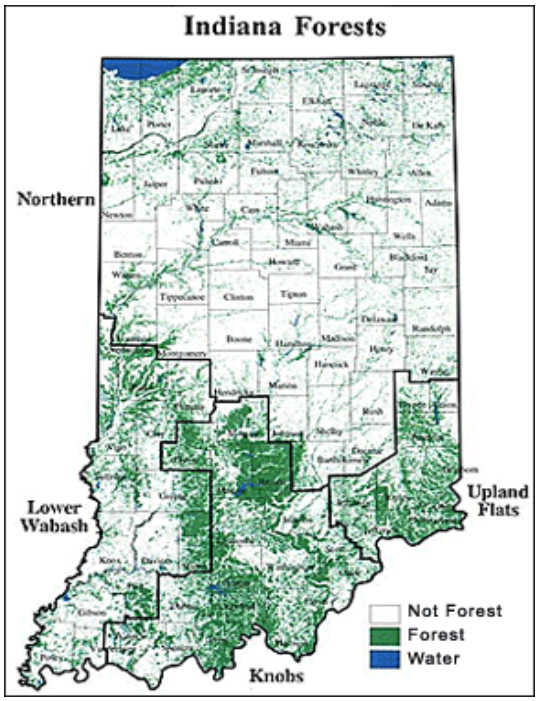
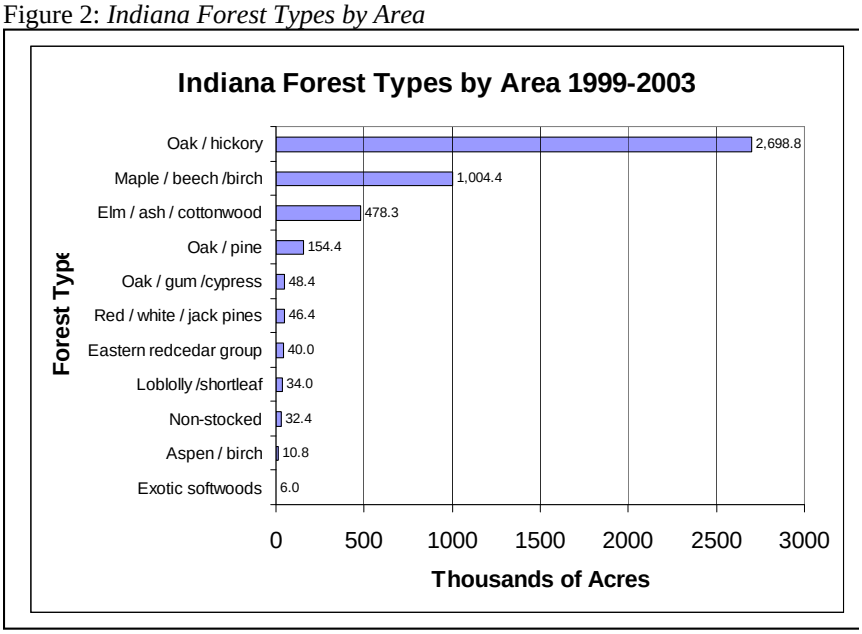


Figure 1 – *Indiana forest areas.*

Growing Stock Volume

The total volume of growing-stock on timberland has been increasing steadily since the 1950 inventory and currently is estimated at 7.5 billion cubic feet. The net volume of hardwood species has increased over the last three inventories, except for white oak. Red oaks, followed by yellow-poplar and white oaks, have the largest growing-stock volume across Indiana. Yellow-poplar, in particular, achieved the greatest gains in overall net volume since 1986. Most hardwood species have shown an increase in larger diameter volumes since 1986 and a stabilization of smaller diameter volumes.

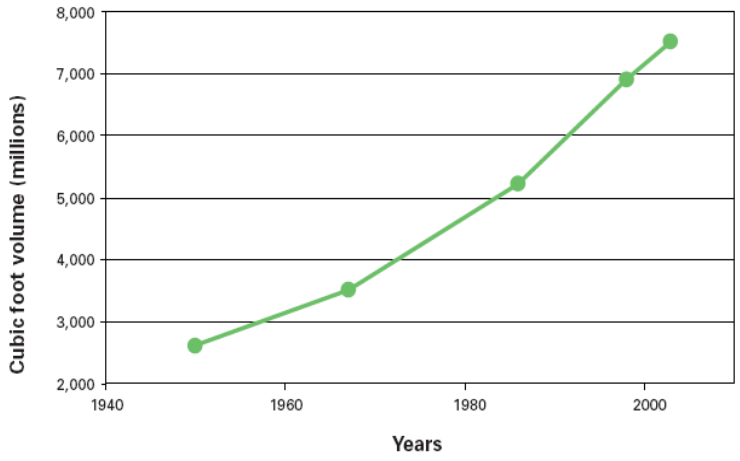
Figure 2: *Indiana Forest Types by Area*



Acre per acre, Indiana's growing stock volume is 11 percent greater than neighboring Michigan's, with board foot volumes 300 percent greater.

Indiana's per-acre standing sawtimber volume dwarfs other states in the region, with nearly double the board feet volume per acre (4,380 board feet versus regional average of 2,328 board feet) of the average found in Michigan, Wisconsin, Minnesota, Illinois, Missouri and Iowa.

Figure 3 – *Cubic foot volume of Indiana Forests 1950 - 2003*



Annual Growth

Average annual net volume growth of Indiana's forests (growing-stock growth minus growing-stock mortality on timberland) has increased substantially since 1967 and is now estimated at 268.1 million cubic feet per year. The steepest increase in average annual net volume growth occurred since the last inventory in 1998.

Forest Products

The contribution of forests to the Indiana economy is over $9 billion annually. Forest harvest produces a stream of income shared by timber owners, managers, marketers, loggers, truckers, and processors. Almost 9,000 people, with a payroll of $220 million, are employed by primary wood harvesters and processors in Indiana. Nearly three-fourths of the 79 million cubic feet of industrial roundwood harvested for the primary wood-using industry came from south-central and southwestern Indiana. 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.

Other important contributions from Indiana's forests include recreation and non-timber forest products such as fuelwood, maple syrup, edible fruits berries, nuts and fungi, and medicinal plants. Income from recreation related to Indiana's forests is estimated to be $1 billion of the $6 billion in recreation dollars spent annually in the state.

Further information available at: Indiana's forests 1999-2003 – Part A and Part B and in Forests of Indiana: Their Economic Importance

2. Forest Health Issues

The 2006 growing season had the following major forest health problems – Gypsy Moth, Forest Tent Caterpillar, and Emerald Ash Borer. In addition, 2006 saw expanding anthracnose, conifer bark beetles, pine plantation mortality, and Dutch elm disease, as forest health problems of a lesser degree. Recurring forest health issues continue with oak wilt, butternut canker, ash yellows, white pine root decline (*Procera* root rot), and pine shoot beetles. Other forest pests of concern (but not yet encountered) for Indiana in 2006 include the exotics – sudden oak death and *Sirex* wood wasp – and a native species – beech blight aphid.

3. Exotic Insect Pests of Indiana Forests

As our economy and current trade practices become increasingly global, so does the potential for more damage by these insects. By conservative estimates, over 2,000 exotic insects are now in the U.S., with over 400 of them feeding on woody plants. Almost every tree genus in the U.S. is affected by at least one exotic insect. Currently, only five of the estimated 400 exotic woody plant pests are regulated by federal quarantine. These include the Japanese beetle, pine shoot beetle, Asian longhorned beetle, emerald ash borer, and gypsy moth. Unfortunately, despite quarantine efforts, damage from these pests and other insect borers remains high.

Three exotic major insects of concern (Gypsy moth, emerald ash borer, *Sirex* wood wasp) utilized significant IDNR resources for monitoring and control activities. The former two are established in Indiana and important threats to the forest base. The latter was first detected in the USA in Indiana, and is known to be established in northern New York state and surrounding areas.

1. Gypsy Moth

Gypsy moth continues as the primary exotic invasive insect. Over 17,000 traps were placed on 2K or 3K grids over the entire state. Indiana efforts to control this pest, while mainly focused on detection, have seen a general trend towards mating disruption and insecticidal control as populations become established in northeastern Indiana. A gradual increase in the numbers of positive detection traps has been noted for eastern-central and southeastern Indiana, leading to a "freckling" of positive traps across the map. This type of increase was first seen in the 1980's in northeastern Indiana, and may indicate the beginning of a second front in this exotic species invasion.

Gypsy Moth Management Zone	Quarantine Area	Slow-The-Spread (STS) Actions	Counties with STS treatments	STS trapping results	Trapping trends outside quarantine and STS area
Activities	Steuben, LaGrange, Elkhart, Noble, DeKalb, Allen, and Porter counties are under quarantine. No defoliation was observed during aerial survey.	26,529 acres on 11 sites were treated with mating disruption; 11,085 acres on 19 sites with Btk. 11 sites were treated with Dimilin from the ground.	Kosciusko, Whitley, Allen, Porter, Noble, St. Joseph, Scott, Elkhart, Lake, and La Grange.	4814 moths were captured in the traps set in the STS Action area.	Traps set by APHIS & IDNR in the remainder of the state below the STS zone captured 146 moths. 25 moths were caught at a Scott County site that was treated in 2006. A trap in Delaware County caught 21 moths, and egg masses were discovered on site. This site will be treated in 2007. All positive traps in 2006 will be delimit trapped in 2007

Table 1: *Gypsy Moth Management in Indiana, 2006*

For Gypsy Moth management, Indiana is divided into 3 zones (Table 1). The "quarantine area" is the portion where gypsy moth is considered established. The "STS Action zone" is the portion of the state where treatment activities are undertaken to limit moth population, and thus "slow the spread" of gypsy moth. The remainder of the state is considered uninfested, and actions may be taken to eradicate any infestations that are found in those areas. Delimit surveys were carried

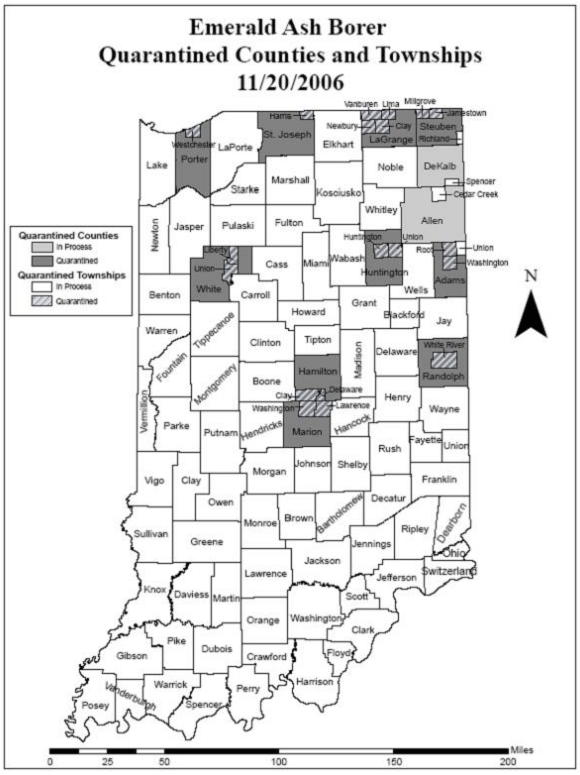
out all positive sites in front of the generally infested area. Aerial spray was carried out using *Bacillus thuringiensis* var. *kurstaki* (Btk) on approximately 11,085 acres (19 sites) and with pheromone flakes on approximately 26,529 acres (11 sites). The intent of the treatment of these 24 sites in 8 counties is to slow the spread of gypsy moth in northern Indiana. One eradication site (378 acres) was treated with Btk in Scott County, in southern Indiana.

2. Emerald Ash Borer

Emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, is an exotic beetle that was discovered in southeastern Michigan near Detroit in the summer of 2002. The adult beetles nibble on ash foliage but cause little damage. The larvae (the immature stage) feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. Emerald ash borer probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia.

On its own, EAB moves slowly through the landscape; natural spread of the insect is about half of a mile or less annually. However, humans can greatly accelerate EAB's spread by moving infested ash wood, especially firewood and logs to un-infested areas.

Figure 4: Emerald Ash Borer quarantines within Indiana as of 11/20/06 *year (IDNR – Division of Entomology)*



Quarantine

When EAB is found in an Indiana township, the entire county will be placed under quarantine for ash products that might move the beetle. Ash products may be moved within the county borders but cannot be taken out of the county without a signed compliance agreement with the Indiana DNR. In addition to the county level quarantine, the township(s) where EAB is actually found will undergo a further quarantine where ash products may not be moved out of the quarantine, not even to the rest of the quarantined county (Figure 4). Finally, a quarantine over the entire state of Indiana has been in effect since December 2006. Regulated articles include ash nursery stock and green lumber; any other ash material including logs, stumps, roots, branches, as well as composted and uncomposted wood chips. Such products may not be moved out of state without inspection and certification from either

Figure 5: *EAB trap tree after girdling.*

USDA/APHIS or IDNR/Division of Entomology inspectors. Development of inspection procedures and compliance agreements is seen as key in thwarting the spread of EAB.

Current Locations in Indiana

EAB has been confirmed in DeKalb County (Spencer Township) during November 2006, the last new county confirmation for the year. DeKalb, Allen, Porter, White, St. Joseph, LaGrange, Steuben, Randolph, Huntington, Hamilton, Marion and Adams counties all had one or more townships with infestations at the end of 2006 (Figure 4). Most of these infestations are not considered "new" introductions; rather we were finding infestations that were probably introduced 4-6 years ago. In many cases, local tree decline and tree death drew the attention of homeowners, park managers, and city forestry officials.

EAB Survey

EAB is believed to be most mobile by human-assisted movement through the conveyance of logs, firewood, and nursery stock. Concern exists that EAB will first spread to sawmills, nurseries, and campgrounds. To survey the extent of EAB near such intercept sites, 25 field personnel from the Division of Forestry and USDA / APHIS were deployed to set approximately 2500 EAB trap trees. Trap trees were created at the center of probable intercept sites as well as within ½ mile in each cardinal direction for a total of 5 trees per site. Trap trees were intentionally wounded by girdling to attract adult EAB. The trees were taken down, and the bark was removed to inspect for EAB larvae during the winter 2006-2007. As of the end of 2006, four trap tree locations (three new townships and one new county) had produced EAB larvae. The locations were (1) new county - Porter County; and (2) new townships - Richland Township in Steuben County; Union Township in Adams County; and Spencer Township in DeKalb County.

For more information, please visit the website for EAB in Indiana:
http://www.entm.purdue.edu/EAB/

3: Sirex Wood Wasp

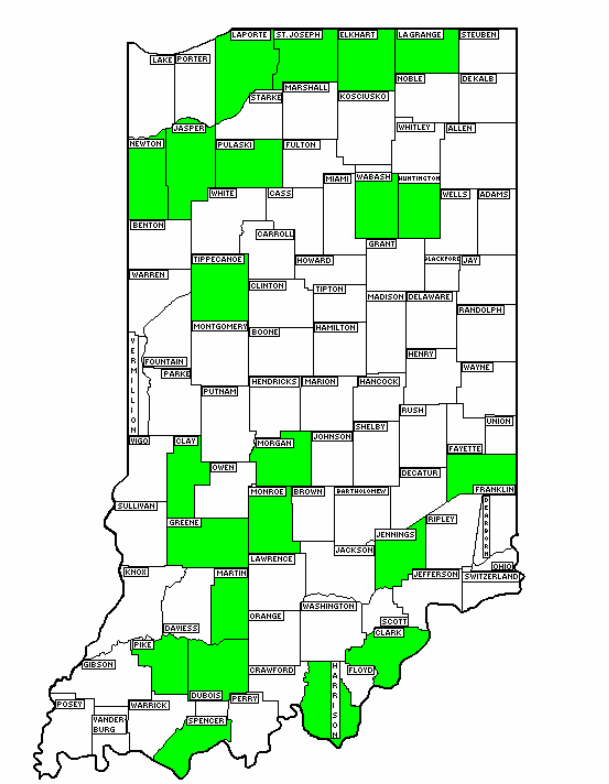
Sirex woodwasp, *Sirex noctilio*, is native to Europe and Asia, and it is an exotic pest of pine plantations in the Southern Hemisphere. It has been recognized as a serious potential threat to our North American pine resource for many years. A single Sirex specimen was found in packing material at an industrial site in Bloomington, Indiana in 2002, but subsequent surveys (Figure 6) have indicated that it is not established near that location. Unlike similar species native to the US, *Sirex noctilio* attacks trees in massive numbers, resulting in rapid loss of vigor and death. Because it is a non-native insect, it is thought to possess great potential for damage.

Survey Methods

IDNR Entomology and Forestry personnel are currently in their fourth year of surveys. Prior years evaluated the use of trap logs, rearing and various insect traps (Lindgren Funnel Trap, Panel Intercept Trap, and Canopy Trap), before settling on the Lindgren Funnel trap. Conclusions of earlier surveys suggested *Sirex noctilio* was not in the survey area, bark beetle competition may have hindered survey, and that bark beetle pressure required new survey technique needed for North America.

The 2006 survey focused on areas of potential establishment. A total of 26 Locations using, 3 trap per location was established during early July 2006. Each trap was set approximately 100 feet apart, and samples collected every two weeks while alpha-pinene lures were replaced every month.

Figure 6: Indiana counties surveyed for Sirex Noctilio during 2006 *year (IDNR – Division of Entomology)*



Results

The 2006 season resulted in the collection of a number of wood-boring wasps. Genera identified included two native siricids (***Sirex nigricornis (58 wasps), Sirex edwardsii(41 wasps)*** and two other closely-related (***Urocerus cressoni(6 wasps), Tremex columba (5 wasps))*** wood boring wasps. Four years of trapping experience indicates that both traps logs and trap trees can be utilized. Both methods require the careful selection of trap material necessary, and both (especially trap logs) are labor intensive and require up to 18 months to generate results. Lindgren funnel traps baited with Alpha pinene appear to be effective at trapping native Siricids. *Sirex noctilio*, however, has not been collected in Indiana with 4 years of surveying.

4. Secondary Exotic Insect Pests of Concern

a. Banded Elm Bark Beetle - *Scolytus schevyrewi*

Scolytus schevyrewi, the banded elm bark beetle, was first collected in insect traps set near Denver, CO and Ogden, UT, in April 2003. By March 2006 it had been collected in 21 states, including Indiana. The coincident finding of *Scolytus schevyrewi* in many states indicates that it has been established for some time.

The banded elm bark beetle has a similar life cycle to that of S. multistriatus, the principal vector of Dutch elm disease. Furthermore it has been observed to be more aggressively colonizing dying elm trees, and poses an unknown risk to Indiana elms both due to its potential harm directly to elms as well as a vector for Dutch elm disease.

More information can be found at: www.na.fs.fed.us/pubs/palerts/banded_elm_beetle/beb.pdf

b. Pine Shoot Beetle - *Tomicus pineperda*

The pine shoot beetle (*Tomicus pineperda*) was first identified in pine plantations in the northern third of the State (Figure 16). The pine shoot beetle is an exotic species from Europe, and was first reported in Indiana in 1992. In Indiana, primary concern is with Christmas tree growers, who are particularly concerned about the potential of this introduced insect to cause destructive losses to their industry. Further concern rests with the extensive planting of pine on public lands in southern Indiana.

Adults quickly colonize recently cut pine stumps, logs, and the trunks of severely weakened trees. There apparently is no practical chemical control for this pest. Cultural practices used in Europe include precise timing of cutting operations and the debarking of cut timber. Yearly surveys for *Tomicus* are conducted by APHIS personnel. In Indiana, *Tomicus* now is found in 61 of the 92 counties (Figure 7). Dearborn county was added to the list of quarantine counties in 2006.

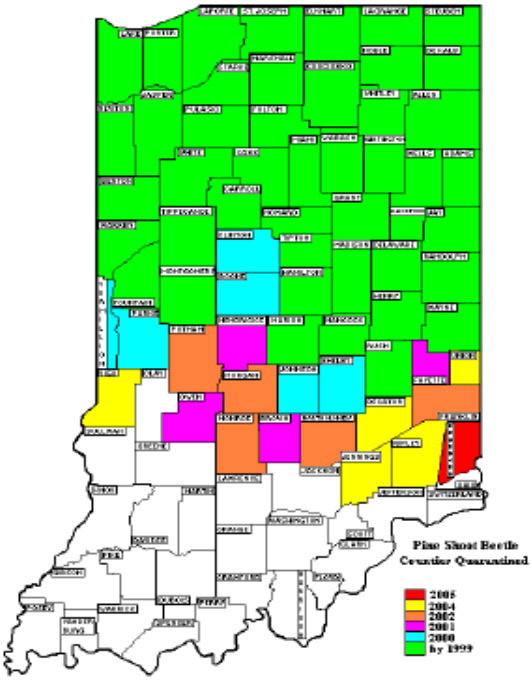


Figure 7: *Indiana pine shoot beetle infestation, by county and year (IDNR – Division of Entomology)*

Under state and federal quarantine law, all nurseries and Christmas tree growers in quarantined counties are required to have an inspection certificate before they can ship pine trees to non-quarantined counties. Pine cut for timber or pulp is also subject to quarantine regulation. It is illegal to move any parts of pine from these counties.

c. Asian Ambrosia Beetle - *Xylosandrus crassiusculus*

Asian Ambrosia Beetle has been identified as a forest pest in Indiana since 2005, when several yellow-poplar trees in Jackson County were killed by the pest. Asian ambrosia beetle (AAB) or granulate ambrosia beetle was first found in the U.S. during 1974 on peach trees near Charleston, SC. In 1983, populations were found as far south as Florida and as far west as Alabama. In 1992, the USDA captured adults with Lindgren funnel traps placed in Johnson County on the southeast side of Indianapolis.

Damage usually appears as small toothpick like projections of frass sticking out of the trunks of infested trees. Frass spikes break off easily in the wind and may not always be seen. Perfectly round, 2 mm entrance holes can be seen when the gummosis and/or frass spikes are removed. Damage usually occurs on the main stem close to the ground, but can be found through out the tree in heavy infestations. AAB appears to be an opportunistic organism attacking trees under stress in Indiana forests. Trees of 3 inch DBH or less are more readily infested than larger trees,

but large, stressed hosts may also be attacked. Heavy infestations usually lead to wilting, dieback and eventual tree death.

Figure 8*: Asian ambrosia beetle – caused yellow-poplar mortality near Medora, IN K.Cote - IDNR*

In 2005, several yellow-poplar were killed by Asian ambrosia beetle (AAB) in Jackson County near Medora. The trees were under stress from high water levels of a newly constructed lake. The Department of Natural Resources is currently conducting surveys and trapping studies to determine the extent of infestations especially at nurseries.

5. Non-Indigenous Plant Pathogens

A large list of non-native plant pathogens has either decimated or now threatens Indiana's forests, including dogwood anthracnose, chestnut blight, butternut canker, Dutch elm disease, and sudden oak death. These diseases, mostly introduced by man from continents halfway around the world, have devastated or threaten to destroy various forest components. State and federal authorities currently are involved to detect, control and eradicate known exotic pathogens. Because of the constantly increasing flow of trade, continuing introductions of new forest pathogens can be expected, warranting continued vigilance in monitoring for new introductions.

1. Sudden Oak Death - *Phytophthora ramorum*

Sudden Oak Death (SOD – *Phytophthora ramorum*) is a recently-described waterborne mold that affects a number of plant species, significantly causing mortality on west coast oak species. Currently SOD has killed hundreds of thousands of oak trees in coastal areas of northern California and Oregon. Among the host species are several popular landscape plants (e.g. rhododendrons) produced in nurseries near infected areas and shipped throughout the country

Concerns exist that SOD may be spread through infected plant materials in nursery stock. While SOD has not established itself in Indiana, predictive models indicate SOD has the potential to infect many forest types found throughout the United States, including the most economically significant portions of Indiana's forest base. Due to the looming economic risk to Indiana oak forests should infestation occur, considerable effort has been expended to survey both trace-forward nurseries and surrounding forest areas for SOD.

Indiana's 2006 SOD Survey

A minimum of thirty sites of interest were planned for *P. ramorum* survey in Indiana, including approximately twenty (20) Nursery Perimeter sites and ten (10) General Forest sites.

Study sites were chosen on a priority basis. Trace-forward nurseries, or Indiana nurseries known to have received stock from West Coast nurseries that had been infected with *P. ramorum*, were first priority sites. General forest areas were chosen according to the presence of dead and/or declining oak trees, or outside a trace-forward nursery, where practical.

Figure 9: *Sudden Oak Death leaf symptoms on alternative host California bay laurel (Umbellularia californica).* ***S****similar leaf symptoms were surveyed for on SOD alternate hosts during the 2006 Indiana survey (IDNR Forestry Phil Marshall)*

In order to detect *P. ramorum* in the forests of Indiana, we used four 100-m transects at each site of interest. The surveyor searched for any plants exhibiting symptoms similar to those of plants infected with *P. ramorum* and collected foliage, twig, or bark samples as warranted. The samples that best exemplified the symptoms exhibited by plants at the site were packed in hard coolers with ice packs and shipped to the regional and local laboratories to be tested for the presence of the pathogen

Results

In Indiana in 2006, 23 Nursery Perimeter sites were surveyed with 45 samples collected and tested from those sites (see Table 1), and 7 General Forest areas contributed 20 samples. All test results were negative for *P. ramorum*.

2. Dutch Elm Disease - *Ophiostoma ulmi (syn. Ceratocystis ulmi)*

Since its introduction into the US, Dutch Elm Disease (DED) has had a devastating effect on native elm populations. With the increasing age classes of Indiana's forests, similarly aging elms are beginning to show a marked increase of mortality through DED. Nearly 25% of U.S Forest Service Forest Health Monitoring (FHM) program plot mortality volume was due to elm mortality chiefly due to DED, on FHM plots 1998 -2002.

Currently Indiana forests are marked by widespread mortality among pole- and sawtimber sized elm, especially American elms. As Indiana forests continue to age, the incidence of DED will probably increase. Forest managers should mark with prejudice elms greater than 16 inches diameter whenever encountered, particularly in stands already expressing DED symptoms to prevent economic loss and reduce the disease base.

3. Oak Wilt - *Ceratocystis fagacearum*

Oak wilt was confirmed from black and red oak in one location in Grant County in 2001. This is the latest county with a confirmed identification, increasing the number of counties with Oak Wilt to 62 (Figure 10). No new counties have been added since 2001.

Oak wilt is predicted to continue as a minor and localized concern in Indiana, with the exception of the sand ridge areas of northwestern Indiana where it is commonly found on black oak stands.

Pockets of trees infected with the disease should be cut and properly treated. Injury to stems, especially in the red oak group, should be avoided to help prevent oak wilt from expanding.

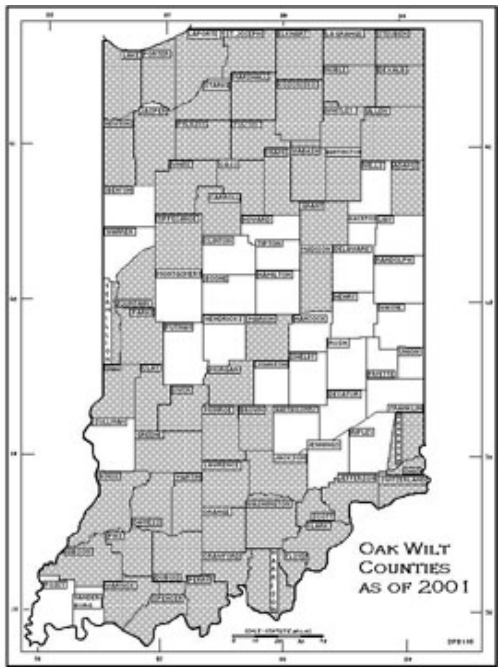


Figure 10: *Extent of oak wilt in Indiana in 2002*

4. Butternut Canker - *Sirococcus clavigignenti-juglandacearum*

Butternut is being decimated throughout Indiana by *Sirococcus clavigignenti-juglandacearum*, a fungus most likely introduced from outside of North America. Butternut Canker was first observed in Wisconsin, in 1967, and has since spread over nearly the entire range of this tree. Cankers develop throughout a tree, and when the resulting callus material encircles the stem, the tree will be girdled and die. The disease is spread by rain-splashed spores, possibly by insects and birds, and perhaps by seeds.

Figure 11: *Butternut canker*

Currently no butternut selections are available that have known canker resistance. A few healthy butternut trees have been found growing among diseased and dying trees and may be resistant to the disease. Reports of resistant butternut continue each year; however work limitations have slowed the screening of the reported trees. Landowners are still encouraged to locate and report healthy butternut to their District Forester, the State Forest Health Specialist or other Division of Forestry employees.

Native Insect and Disease Concerns

1. Forest Tent Caterpillar

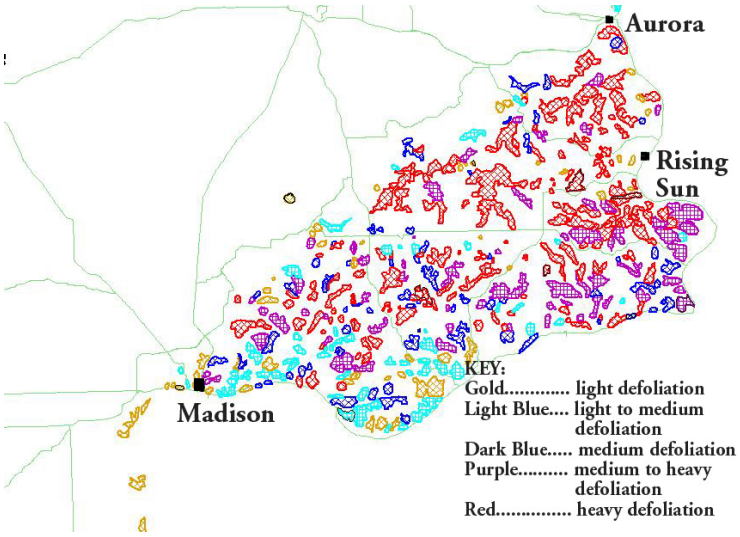
The **Forest Tent Caterpillar** (FTC) epidemic in Southeast Indiana continued in 2006, resulting in moderate to severe defoliation in six Indiana counties. This epidemic is the northwestern edge of a multi-state epidemic centered in Kentucky. While the epidemic has become more dispersed and moved north from its original location, significant damage is still expected in the northern part of the epidemic area.

Table 2: *2006 Indiana Forest Tent Caterpillar Defoliation*							
Acres defoliated, by severity class and county							
Defoliation Level	**Clark**	**Dearborn**	**Jefferson**	**Ohio**	**Ripley**	**Switzerland**	**TOTAL**
1	3,457	315	3,230	711		2,379	10,092
1-2		626	3,554	1,658	59	4,317	10,214
2		653	2,351	544	239	5,184	8,971
2-3			2,597			11,391	13,988
3		1,650	2,932	10,926	102	15,324	30,934
TOTAL	3,457	3,243	14,665	13,839	400	38,595	**74,199**

The fourth consecutive year of noticeable defoliation by FTC continued in the southeastern counties of Jefferson and Switzerland, and expanded into Ohio, Dearborn, and Ripley counties (Table 2). FTC defoliation ranged from light to severe with the majority of acres defoliated in the moderate to severe class (Figure 12). Defoliation has expanded dramatically by 50 to 100% each year, from 19,248 acres in 2003 to 74,199 in 2006.

The primary species defoliated included the oaks and sugar maple. Other species defoliated include black cherry and hickory. Mortality to oaks, especially black oak, and sugar maple has started to occur, but was only observed in scattered individual trees. Mortality has increased in 2006 after the fourth year of defoliation and from the late summer drought in 2004.

Figure 12: *2006 Forest Tent Caterpillar defoliation in extreme southeastern Indiana*



The last time FTC defoliated the forests of Indiana was in the late 1970's and that epidemic collapsed after the third year. Although defoliation in this infestation is expected in 2007, it should be decreasing in area and intensity because natural control should start to occur. One of the natural controls – the 'Friendly Fly', *Sarcophaga aldrichi*, is has begun to become involved, with large populations reported in Madison on the Ohio River.

2. Ash Yellows

Ash Yellows (also known as Ash Decline) continues to be found across the state primarily on white and green ash. The disease is caused by a microbe that resembles bacteria which lack cell walls, but have many differences and are grouped differently. These microbes are called mycoplasma-like organisms (MLO), and are possibly transmitted by leafhoppers. Symptoms of the disease, especially crown dieback and growth loss, are more prevalent in the northern part of the state. It is generally more common to observe the disease on wetter sites, but witches'-brooms (a diagnostic symptom) also can be found on trees growing on dryer sites. Trees in an advanced state of decline have the greatest change with 7% dying annually. Cumulative mortality over this

period was greatest in trees with advanced decline, about 49%. Healthy trees and early declining trees had mortality of 2% and 5%, respectively.

Landowners and forest managers should approach Ash Yellows as a chronic condition requiring long-term rather than immediate attention. Removal of affected ash trees can be considered over a long-term (e.g. 10 year) planning horizon, which coincides with cutting cycles for uneven-aged management on better-quality Indiana woodlands.

3. White Pine Root Decline - *Verticicladiella procera*

Procera Root Rot (White Pine Root Decline) has been noticeably killing white pine across the state for more than 10 years. During 2006, mortality from this disease continued its role as the most common request for assistance. It continues to kill windbreak, yard and plantation trees. This disease is the most common forest pest that landowners request assistance, and as such has the status of the number one disease in Indiana.

Trees from 4 to 30 feet tall and 3 to 6 inches in diameter are commonly killed. Trees can turn brown in color at any time of the year, but do so more commonly in the spring and fall. Infected trees appear light green and sparse or thin at first. Then the trees turn brown in a short period of time. Most landowners do not recognize the early symptoms of the disease. They usually see the dead brown tree and sawdust from woodborers that attack the dead tree. Management of the disease is done by using sanitation measures. There is no cure or preventative treatment for the disease.

USDA, Forest Service, S&PF

Figure 13: *Procera Root Rot tends to affect single trees in windbreaks*

4. Anthracnose

The wet spring and summer produced yet another year of moderate to heavy defoliation of sycamore from anthracnose across the state. In certain instances, some people confused anthracnose with frost damage, which is superficially resembles. The majority of the defoliation was in the northern part of the state. Oak, maple and ash also had damage but to a lesser degree than the highly susceptible sycamore. Anthracnose in walnuts, which occurs later in the summer, was also more recorded in 2006.

The causal fungi for hardwood anthracnoses encompass several genera, and not all hardwoods are affected equally. Sycamore is the most susceptible species, and is the gauge that is used to determine the severity of anthracnose each year. Other species vary as to their susceptibility. For example, most oaks in the white oak group are more susceptible to anthracnose than those in the red oak group. Pin oak, swamp chestnut oak (a white oak group member), and bur oak are only rarely affected.

It is impractical and impossible to control anthracnose in forest stands. For urban forests and nursery stock, anthracnose may be regulated by raking leaves and pruning infected twigs and

branches. This reduces the amount of overwintering fungi in plant materials that is available to cause infection during the next growing season.

5. White Oak Mortality

Several reports of white oak and chestnut oak groups dying have been received from 2004 until the present. Receiving reports of white oak dying is unexpected. Normally the white oak group is more resistant to death from various stress factors compared to the red oak group. Examination of two sites in southern Indiana (Orange & Putnam Counties) and one in northern Indiana (Lake County) found that Two Lined Chestnut Borer and Armillaria Root Rot were involved in the decline and death of the white oak. Again, making the report of white oak mortality unusual was that the red oak group species observed in the sites were not declining or dying.

Figure 14: *Typical gallery of the two-lined chestnut borer A. bilineatus*

A. bilineatus attacks primarily oaks trees, weakened by various stress factors including drought and defoliation. The larvae bore into the inner bark, begin feeding and form meandering galleries in the inner bark and outer wood (Figure 14). The feeding galleries of many larvae in a heavy infestation effectively girdle the tree by blocking the movement of food to the roots and water to the shoots. These borers first infest the upper crown; later infestations are lower and often reach the base of the tree. The combined actions of the borer in the stem and the fungus in the roots (Figure 11) can bring about rapid decline and death.

Scattered white oak mortality has been observed in Morgan, Jackson, and Orange counties and is probably more widespread than reported. In areas were groups of white oak trees are dying, salvage harvest operations should be implemented to preserve the timber value and contain further spread of two-lined chestnut borers.

6. Decline in Yellow-poplar and Hickory

Tree decline is a complex disease with no single cause. For yellow poplar and bitternut/pignut hickories, Indiana foresters have observed trees with dieback and decline symptoms at all ages and sizes. Under stress, the bark splits open and peels off the main stem starting in the lower part of the tree crown and the splits continue to root collar, killing the tree.

The IDNR concluded a study of yellow-poplar and hickory decline in south-central and south-eastern Indiana in 2005. After noting a general occurrence of tree declines and death beginning in 2003, the reports of such incidents have decreased. Through this research, it was reaffirmed that yellow-poplar decline is strongly associated with prolonged drought events. In particular, decline symptoms were most pronounced on exposed southern slopes, and first appeared after the 1999 and 2002 droughts. Decline symptoms and mortality were most pronounced on smaller-diameter trees with suppressed crowns. Interestingly, there was no correlation between high stand density and decline symptoms.

With bitternut and pignut hickory, certain trees decline and suddenly die. Shagbark and other loose bark hickory, even when associated with bitternut hickory in the same forest, do not decline and die. Reports from Iowa suggest a newly described fungus, *Ceratocystis smalleyii*, and a new sister species (*C. caryae*) as potential causal agents. Greenhouse research has suggested that *C. smalleyii* might play a significant role in hickory mortality. Attempts in Indiana to culture active cankers from the field have not yet been successful, and the role of *Ceratocystis* sp. in Indiana's hickory decline remains speculative.

7. Looper Complex – Linden Looper *Erannis tiliaria* and Half Winged Geometer *Phigalia titea*

Figure 15: *2003 Looper Complex defoliation in Washington County*

Dramatic, cyclical defoliation events have been noted in southern Indiana, caused by the native half-wing geometer and linden looper – hence the name "Looper Complex", for over 30 years. Hosts of these insects include most hardwood trees, including various oaks, hickories, and red maple. Their populations exist at low to moderate levels, and then expand dramatically every 10 to 20 years.

The last epidemic began in 2001/02 with very light defoliation observed in Clark, Jackson-Washington and Harrison-Crawford State Forests and the Tell City Ranger District of the Hoosier National Forest. In 2003, the epidemic developed over a multi-county area of south central Indiana that included these forests. Light to heavy defoliation occurred in the forests and the associated private lands totaling 89,252 acres.

The epidemic continued through 2004 in these areas and expanded to Yellowwood State Forest, Brown County State Park, the Deam Wilderness and surrounding area on the Hoosier National Forest. Light to heavy defoliation totaled 131,943 acres. Again, Clark and Jackson-Washington State Forests sustained some of the heaviest defoliation. But the severest defoliation occurred in 2004 in Brown County State Park and the Nebo Ridge and Houston area of the Hoosier National Forest in Jackson County (see Indiana Forest Health Highlights 2003 and 2004).

The epidemic collapsed by the spring of 2005. Aerial and field surveys to date have not detected noticeable defoliation or significant insect levels. Responsibility in part for the collapse was due to the presence of a parasitic fly (the 'Friendly Fly', *Sarcophaga aldrichi*) that attacks the caterpillar.

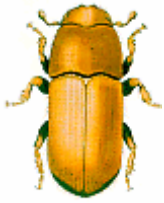


Figure 17: *Southern Pine Beetle*

8. Conifer Bark Beetles and Pine Plantation Mortality

The pine forests of Indiana are commonly found on state and national forests in southern Indiana. These forests are reaching maturity and in many situations have

increased in density from a lack of management activity. As the density increases, the trees are exposed to stress from competition with each other.

There are several pine bark beetle species in Indiana that are starting to take advantage of this tree stress to attack Indiana pines. From these attacks, the beetles build a population that will grow in capacity to attack health pines as well. Bark beetles involved include *Ips* bark beetles, *Ips pini* or *Ips grandicollis*, and turpentine beetles, *Dendroctonus tenebrans and D. valens*. (http://www.ces.purdue.edu/extmedia/BP/BP-35.html)

The management of this forest health problem is best achieved using surveys to monitor the status of pine stands, coupled with quickly applied salvage harvests in infested stands. Preventative measures include thinning unaffected high-density pine stands. Because attacked pines usually die within one growing season and secondary insects quickly render wood useless, salvage operations must be rapidly executed. Importantly, pine bark beetles typically produce 2-3 generations in one growing season. They can expand their populations quickly and possibly attack remaining healthy trees.

The future for pine stands across Indiana includes the increased presence of pine bark beetles and the death of pines in groups or scattered individual trees. Forest management activities that reduce stand density and promote radial growth are measures that can manage the impact of pine bark beetles.

Miscellaneous Forest Pest Concerns for 2006

The following miscellaneous insect and disease pests were reported by landowners and natural resource professionals for 2006. Their appearance was reported in some instances to be locally destructive, but overall they were not a widespread concern to the forest base. Hypertext links to forest pest factsheets may be linked to by following the imbedded links in the common names of each pest:

Insects:

Bagworms (*Thyridopteryx ephemeraeformis*); Yellow-poplar scale (*Toumeyella liriodendri*); Pine Needle Scale; Oystershell Scale (*Lepidosaphes ulmi*); Pine Needle Scale (*Chionaspis pinifoliae*); Fall Webworm (*Hyphantria cunea*); Eastern Tent Caterpillar (*Malacosoma americanum)*; Locust Leaf Miner (*Odontata dorsalis*), Zimmerman Moth (*Dioryctria zimmermani*); Elm Leaf Beetles (*Pyrralta luteola*); Walnut Caterpillar (*Datana integerrima*); Sawflies; Spidermites.

Diseases:

Verticillium Wilt; Oak Tatters; Fire Blight; Apple, Hawthorn rust and scab;

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