

# IOWA'S FOREST HEALTH REPORT, 2008

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## Introduction

Each year the Iowa DNR Bureau of Forestry cooperates with numerous agencies to protect Iowa's forests from insects, diseases, and other damaging agents. These programs involve ground and aerial surveys, setting up sentinel trees, setting up pheromone traps, following transects for sampling, collecting samples for laboratory analysis, and directing treatments for specific problems during the growing season. After each growing season, the Forestry Bureau issues a summary report regarding the health of Iowa's forests.

This year's report begins with a brief summary of weather events, followed by a summary of Forest Service Inventory data for Iowa's forests, showing that there isn't an oak species that is represented in Iowa's top 10 species, survey summaries for insects and diseases that have the potential to impact Iowa's forests. The 2008 surveys for exotics insects and diseases were Emerald Ash Borer and Gypsy Moth survey. Oak tatters research describes some new intriguing information discovered in 2008. This report finishes up by describing forest insects and diseases already present, and concludes with invasive plant species in our forests.

## Weather

This winter brought tremendous snow loads to the state. The melting of the heavy snow load, in conjunction with heavy rain fall events, resulted in heavy flooding throughout the state. During April, the rain amounts averaged 3-5 inches per rainfall in eastern Iowa, and 2-4 inches in central Iowa. The heavy

rainfall events brought about chlorosis in many species. The species hit the hardest included: silver maple, river birch, hackberry, hickory, and some oaks. The heavy rainfall events, combined with the cool wet spring, resulted in leaf drop in hackberry in northern Iowa and a higher than normal amount of Anthracnose (a fungal leaf disease) on sycamore. Both hackberry and sycamore trees produced a new flush of leaves within a few weeks as expected.

## Aerial Survey

Iowa forests surveyed by plane in 2008 were found to be in generally good condition. On August 15, the surveying crew started above Ames, IA and flew north to Yellow River State Forest following the Mississippi River south to Clinton, IA. On August 19, the surveying flew Des Moines River until it met up with the Mississippi River. The flight crew followed the Mississippi River north to Muscatine, IA, where they then followed the Iowa River back to Marshalltown. Observance along this route showed tremendous damage from the spring floods. Silver maple and cottonwood trees showed chlorotic symptoms in their leaves from their water saturated soils.

Most counties along the route also showed signs of Dutch elm disease (DED). A



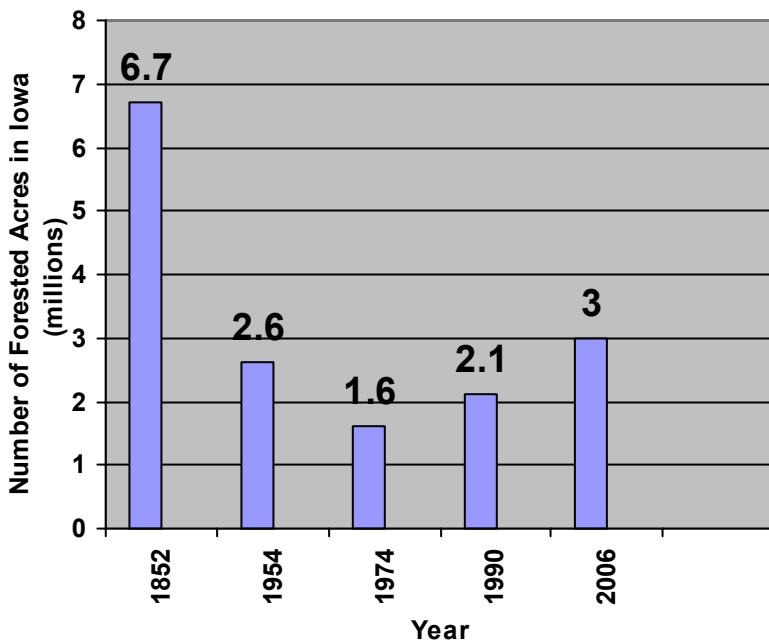
large population of lace bugs caused oak leaves to look discolored in late August. Scattered trees with lace bug damage were noticed throughout the state, with most of the damaged trees occurring South of Highway 30. The aerial flights found lower levels of Pine Wilt and Oak wilt than was noted in the 2007 aerial survey. In addition, the aerial flight found large pockets of aspen declining in NE Iowa.

# THE SIZE AND CHARACTER OF IOWA'S FORESTED LAND

Iowa's forests are generally healthy and are increasing in the number of acres. A forest resource that is healthy contributes immensely to our state's goals of clean water, abundant wildlife habitat, lumber and veneer production, outdoor recreation and aesthetics that enhances the quality of life in Iowa for the citizen of Iowa.

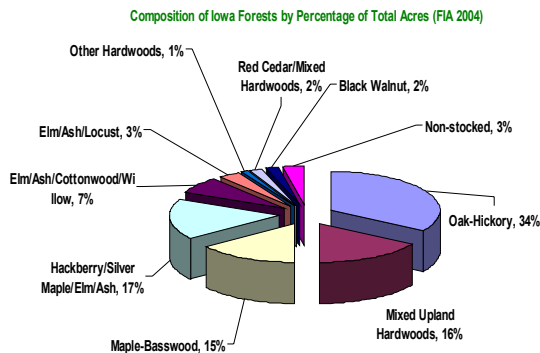
Iowa has approximately 3.0 million acres of forested land representing a steady increase over the past few decades as shown in Figure 1 below. However, with less cost share funds available and increasing corn and soybean prices we are seeing many of the newly planted area shift back in the croplands. Most Iowa forests are native hardwood with oak, hickory, maple, basswood, walnut, ash, elm, cottonwood and many other hardwood species. Less than 3% of Iowa forests are conifer forests.

**Figure 1. History of Iowa's Land Covered in Forest since Settlement.**



Even though Iowa forests are increasing in acreage, the oak component is decreasing in some areas of the state, as forest succession drifts toward more shade-tolerant species such as maple in the absence of forest disturbance. There are currently 927,200 acres of oak-forest in Iowa. Iowa has lost an average of 4,500 acres of oak forest annually since 1990. At the current rate of decline oak forests will disappear from the Iowa landscape in 160 years without proper land management. It is important for landowners to work with DNR Foresters to use silvicultural systems to counter this trend to regenerate oak. A

breakdown of the different forest communities in Iowa is shown in the pie-graph below.



Succession to shade tolerant hardwoods eventually replaces shade intolerant hardwoods, like oak, in the absence of disturbance. Most of Iowa's oak stands are in the mature or over-mature age. Prior to settlement periodic prairie fires swept into the woodlands and eliminated mid-story layers, thus giving the thicker barked oak a competitive advantage over other species. That is largely why we have oak today. However, many of these stands are now 150+ years old. These stands may be reaching the twilight of their life span. Without fire or disturbance oak seedlings cannot get the light they need to survive. When the fire ecosystem is eliminated shade tolerant species like sugar maple are in a position to fill the void.

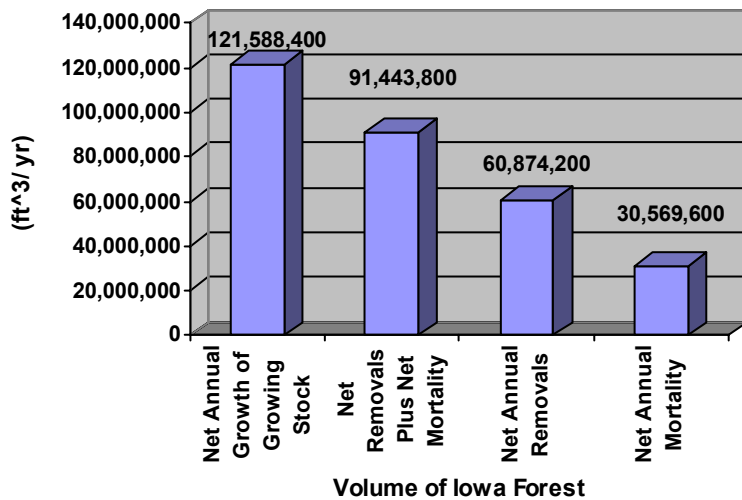
Iowa's oak forests within the white oak group has a sporadic seed production, exception bur oak, only producing good seed crops once every five years on average. This makes the timing of silvicultural treatments or harvesting very important to the regeneration of oak stands. Another challenge for maintaining oak forests localized heavy deer populations that eat oak seedlings and keep them browsed to a point where other less palatable species out compete the oak. Numerous researchers have determined estimates for ecosystem carrying capacity that range anywhere from 10 to 30 deer per square mile of forest habitat.

Fragmentation of forest land into smaller tracts with houses near or in the timber make the management practices for oak less feasible for landowners, because they do not want to "ruin" their woods. Most people want to preserve their forests with big trees thinking that this will keep their forest in its current condition. The woodland becomes an extension off their yard not a forest. People generally believe that by doing nothing that they can preserve their forest, when in reality it takes disturbance to maintain an oak-hickory forest type. Many of the oak regeneration issues can be addressed through proper application of silvicultural techniques and forest management.

Harvesting activities do not destroy the woodland wildflower and forb seed bank, even in heavily scarified sites. Plants such as Anemone, blood root, Blue cohosh, fern come back in reaction to the disturbance and additional light. They are more likely to disappear under a very dense canopy of shade tolerant hardwoods.

Even though Iowa's forest land is currently increasing, the land is becoming more fragmented and the species growing on the land is converting to more shade tolerant species. Iowa has about 8% of its land classified as forest, according to 2006 Forest Inventory Data provided by the Forest Service. That means about 3.0 million acres of Iowa is forested. Most of Iowa's forest land is privately owned, 90% by 138,000 landowners. In 1990 there were 55,000 forest landowners in Iowa that owned on average of 31 acres of forest land. By 2004 the number of forest landowners increased to 138,000 with an average of 12 acres of forested land. Development is fragmenting the forest cover in Iowa. This will make it more difficult to manage the forest resource, as there will be so many more people with different opinions on how they want their forest to grow.

Net annual growth exceeded the combined removal and mortality of Iowa's forestland by over 30 million board feet in 2006, the latest FIA data available. This data is shown in the following bar graph.



The graph and Table 1 in Appendix A shows based on 2006 FIA data, that 24% of our current forests are composed of tree species that are not expected to be long lived. Elm (Dutch elm disease), ash (Emerald Ash Borer) scotch pine (Pine Wilt) are all in peril because of insects and diseases that pose serious threats to their survival in the future. What will Iowa's forests look like for the next generation? Notice that no oak tree even cracks the top ten for species ranking.

### **The Value of Iowa's Forests**

Over 300 businesses in Iowa utilize the wood grown in Iowa's forests. The forest products industry contributes over \$1 billion each year to Iowa's economy, including over 25,000 jobs for Iowans. (2002 Manufacturing Data)

Many of the finest quality black walnut, oak and maple trees in the world are grown in Iowa. These trees are exported over seas to countries like China, Japan and Germany. Iowa is one of the leading states in the U.S. for the export of veneer walnut.

In 1999 Iowa's private landowners received over \$14 million in stumpage payments for their timber. That value rose to over \$22 million in 2007. Iowa's 300 Christmas tree growers sell over 50,000 trees annually, yielding more than \$500,000.

### **Emerald Ash Borer Surveillance Effort**

The Emerald Ash Borer (EAB) is native to the Orient, and was introduced in the United States near Detroit in the 1990's. On December 1, 2006 a quarantine was placed by USDA-APHIS for the entire states of Illinois, Indiana and Ohio. The lower peninsula of Michigan is under this quarantine, also. The federal order prohibits the interstate movement of ash nursery stock, ash green lumber, and any other materials including logs, stumps, roots, branches, composted and un-composted chips. Due to the difficulty of distinguishing between species of hardwood firewood, all hardwood firewood is included in this quarantine.

Although not yet found in Iowa, EAB has more potential for future harm to Iowa forests and urban communities than any other insect currently being dealt with in the United States. EAB kills all ash species by burrowing under the bark and eating the growth (cambium) layers of the trees. EAB has been found capable of killing every species and size of ash tree in neighborhoods or woodlands. Ash is one of the most abundant native tree species in North America, and has been a preferred and heavily planted landscape tree in yards and other urban areas.

### **Iowa Emerald Ash Borer Surveillance Effort – 2008**

The Iowa Department of Natural Resources (IDNR) Forestry Bureau in cooperation with Iowa State University Extension (ISUE) and Iowa Department of Agriculture (IDALS) State Entomologist Office have been following the United States Department of Agriculture Forest Service (USFS) protocol to monitor Iowa for signs of the emerald ash borer (EAB). The detection of EAB in Peru, IL in July 2007 places this insect only 85 miles away from Davenport, IA, which is of concern because of its proximity to Iowa and Interstate 80 linking the two states. Furthermore, the confirmation of EAB in Missouri and Wisconsin in 2008 is of great concern. According to recent sources, Iowa has an estimated 50 million rural ash trees (USFS 2006) and 30 million urban ash trees (USFS 2008).

### **Visual surveys:**

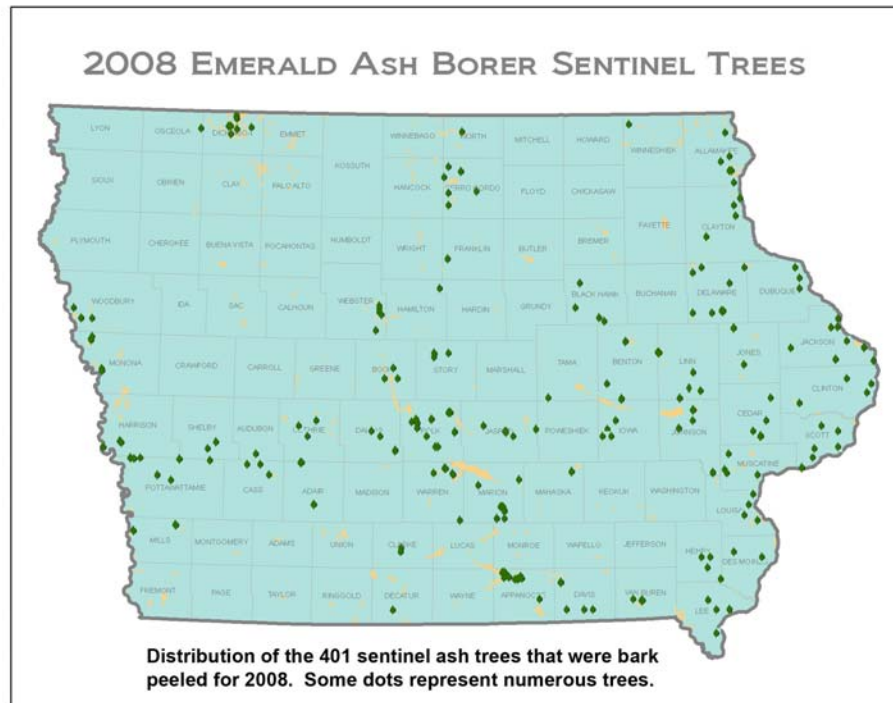
A surveillance effort has been in place the past five years in Iowa to look for EAB. For 2004 and 2005, this activity consisted of visual surveys of urban ash trees (towns/cities with a population greater than 1000) in all 99 counties, visual inspection of ash saw logs at 43 sawmills, and ash nursery stock. Visual surveys in 2004 involved 2078 trees on 252 sites, and in 2005 involved 1318 trees on 238 sites.

During the 2006, 2007, and 2008 season, surveillance strategy shifted to the highest risk areas in the state, campgrounds. Sites were selected based on location near interstate highways, near tourism sites, and/or on the eastern border of Iowa. Up to 10 trees were examined in each campground for signs of EAB. The larger the campground and the greater the ash density, the more ash trees visually examined. In 2006, 417 ash trees were visually examined in 50 state and 10 county campgrounds. In 2007 EAB visual surveillance increased to 400 campgrounds (all federal, all state, all private and large campgrounds in 69 counties) involving 1102 trees. In 2008, 235 campgrounds in 55 counties were identified as high risk sites and 1,269 ash trees were inspected. No evidence of EAB was noted during visual surveillance in Iowa (2004 – 2008).

### **Sentinel trees:**

Sentinel trees in Iowa were created in one of two ways: girdling standing ash trees (4-13 inch DBH) or planting donated containerized ash trees (approximately 3 inch caliper). Sentinel trees were established by June 1 each season. In general, containerized trees were used for private campgrounds or in areas with few ash trees, while standing ash trees were used on federal, state or county properties. A tree was girdled by using a folding hand saw, making two cuts through the bark (4 – 6 inches apart), and then removing the bark with a drawknife between the cuts. Every effort was made to select standing ash either in the open or with exposure on two or three sides; trees were rejected as possible sentinel trees if they were within a forest stand.

In 2005, **48** sentinel trees (23 standing, 25 container) on 12 sites were also used to monitor for EAB. In 2006, **68** sentinel trees (27 standing, 41 container) were established on 18 sites; 10 were retained for evaluation in 2007. In 2007, **237** sentinel trees (190 standing, 47 container) were established on 57 sites. In 2008, **401** sentinel trees (272 standing, 129 container). During the fall of each year, sentinel trees were bark peeled on site. New sentinel trees for monitoring the following season were girdled before leaving the site. EAB has not been detected in any sentinel tree to date.



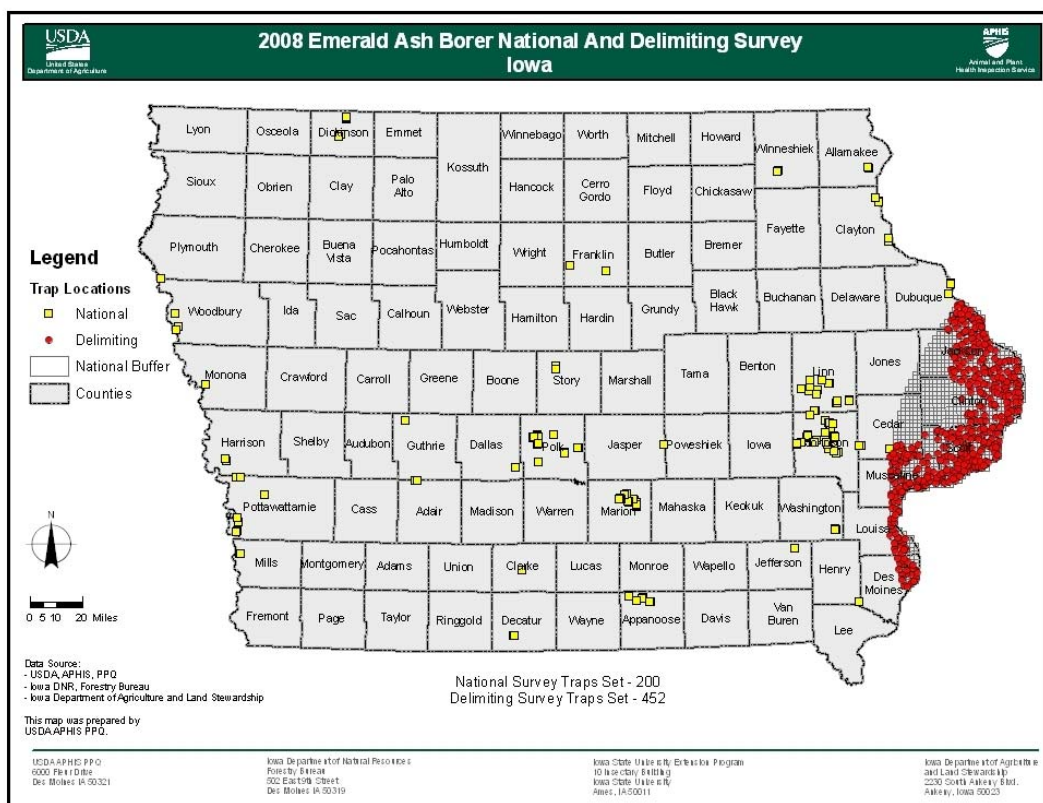
**USDA Experimental Traps:**

During 2008, 652 purple sticky traps were obtained from USDA for detection efforts in Iowa. Traps were installed in June and a midseason trap check was conducted approximately one month after placement, collecting suspect beetles, recoating panels with Tanglefoot, and reinstalling traps in the canopy. All traps were removed by the end of August 2008, suspect insects collected, and traps were discarded.



EAB was not found on any of the 652 purple traps that were hung in the 2008 trapping season. The above picture is an example of an EAB purple trap in an ash tree.





### **EAB Outreach:**

Educational efforts in Iowa during 2008 included the following:

- EAB posters, wallet size ID cards and fact sheets (USFS Pest Alert and USDA APHIS Green Menace) were provided to all EAB sentinel tree sites, Department of Transportation Rest Areas, sawmills, and campgrounds that were visually monitored.
- Bark peeling workshops were hosted in Cherokee, Dallas Center, and Cedar Rapids in an effort to train city personnel and arborist on how to look for EAB in suspect trees.
- During visual survey work and sentinel tree establishment, collaborators and contractors visited with park rangers/facility managers about EAB, either updating them on this pest or providing initial education on identification, importance, firewood transport, and contact information. EAB information was provided.
- Presentations were made by collaborators to many audiences, including the U.S. Army Corps of Engineers Foresters, ISUE county meetings Cooperative Weed Management Associations, Iowa Arborist Association, Iowa Turfgrass, Iowa Association of Municipal Utilities, and the Iowa League of Cities.
- EAB was the theme for the IDALS State Entomologist section at the Iowa State Fair.

- Bill boards with the message of do not bring out of state firewood to Iowa were rented. A single page fact sheet outlining the problems associated with bringing firewood to Iowa from out of state was placed in every out-of-state license application that was mailed (47,000 out of state hunters in Iowa annually).
- On-line registration for state parks included a message about not bringing firewood into Iowa if visiting from out of state.
- IDNR sent out regular press releases informing Iowa citizens about the EAB and the trapping methods being used.
- ISUE has a Web page dedicated to providing information to Iowa citizens on EAB. Items on this site include EAB Readiness Plan, Upcoming Training Sessions, PowerPoint slide presentations with scripts, Shade Tree Alternatives, an EAB Image Gallery, and links to the national EAB Web site. The URL for this site is:  
<http://www.extension.iastate.edu/pme/home/pests/EAB.php>

A map showing the current known locations of EAB in the United States can be viewed in Map 1 in Appendix B. Also in Appendix B, Map 2 shows the distribution of ash across the United States that is at risk to this exotic insect.

For more information on the most current status of the EAB log onto [www.emeraldashborer.info](http://www.emeraldashborer.info).

The longer we can keep Iowa free of the emerald ash borer, the longer ash trees will still be a viable tree in the landscape. Hopefully researchers will soon come up with a better detection system and/ or a way to contain this destructive insect.

## **Gypsy Moth Survey**

Gypsy Moth is a European insect species introduced into New England over 100 years ago as an experiment to help provide silk for the textile industry. This exotic insect continues to spread west from that introduction site and defoliate native forests wherever they become established. Establishment of gypsy moth in Iowa will affect the survival of our mature and oldest trees the most. The larvae of this insect will feed on the leaves of its over 300 host species during the summer removing a tree's ability to create food with its leaves. It is repeated defoliation that occurs several years in a row on the same trees that will deplete the stored reservoirs of nutrients the tree has, thus leading to the decline of that tree.

Gypsy Moth has established itself in eastern Wisconsin now, and is just beginning to move towards northeast Iowa. Through Iowa's trapping program and follow up treatments, Gypsy Moth has been kept from becoming established in Iowa, but there are now 5 counties (Allamakee, Clayton, Dubuque, Jackson, Clinton) within 60 miles of the gypsy moth establishment boundary line. Furthermore, Wisconsin is reporting that the gypsy moth population is building in neighboring Adams, Columbia, Dane, Marathon and Sauk counties.

The 2008 summer season provided the largest catch of male gypsy moths in state history. There were 626 moths caught in 495 traps throughout the state, but most catches were made in NE IA, the area closest to the established population in WI. Many traps this year had multiple moths in them compared to previous years.

Weather patterns along with an introduced fungus disease for gypsy moth called *entomophaga maimaiga* and a federal program called “slow the spread” (STS) have combined to slow the spread of gypsy moth into Iowa. Budget cuts to the 2008 STS budget reduced treatments that were needed and as a result, the spread of this insect across Iowa will be faster than historical rates. Continued cuts to the STS budget are being proposed for the federal fiscal year 2009. For more information about the STS program visit their website at: <http://da.ento.vt.edu/index.html>

Map 1 in Appendix C shows the locations of the gypsy moth catches in Iowa for 2008.

A history of the number of gypsy moth catches and the number of acres treated for gypsy moth eradication in Iowa between 1970-2008 can be viewed in Table 1 of Appendix C. For more background information and the latest national maps for the movement of gypsy moth visit [www.aphis.usda.gov/ppq/ispm/gm/](http://www.aphis.usda.gov/ppq/ispm/gm/).

### **Background Information**

The Iowa Department of Agriculture and Land Stewardship (IDALS) in cooperation with USDA-APHIS-PPQ have conducted an annual male moth detection trapping program since the 1960's. In 2001 the Iowa Department of Natural Resources (IADNR) Forestry Bureau became involved with the gypsy moth trapping program because of budget cuts to the IDALS gypsy moth detection program. Forestry believes this is an important issue for Iowa's forest resource and has since provided labor in the form of its district foresters and contractors to help with the surveying of the 99 counties in Iowa.

### **Eradication Efforts**

Eradication prevents establishment of the gypsy moth in new areas by eliminating isolated populations. Indications of isolated populations include: 1.) male moths caught in pheromone traps; or 2.) the presence of other moth life stages.

Eradication programs, utilizing insecticide spraying of a *Bacillus thuringiensis* (Bt) var. *kurstaki* are implemented by IDALS and USDA-APHIS-PPQ to eliminate the gypsy moth populations in Iowa. Bt is a pesticide derived from a bacterial toxin that affects only certain butterfly and moth larvae. A history of acreage treated with Bt since 1972 to eradicate gypsy moth is also shown in Table 1 in Appendix C.

IDALS in cooperation with IADNR and USDA Forest Service have conducted extensive professional and general public education efforts. These efforts have ranged from the publication of gypsy moth brochures and identification cards, to formal training programs for professional nursery, arborists and foresters, and workshops for the general public and volunteers.

**Current**

The gypsy moth trap locations in 2008 were focused within cities, campgrounds, and around nursery operations. Along the Mississippi a trap was placed every 1500 meters to form a line of detection along Iowa’s eastern border. Nine of our largest cities were also put on a 1500 meter grid.

In 2008 the following agencies were involved with gypsy moth trapping:

<b>Agency</b>	<b>Employees</b>	<b>Traps</b>
<b>IDALS</b>	<b>4</b>	<b>226</b>
<b>PPQ</b>	<b>4</b>	<b>1445</b>
<b>Contractors</b>	<b>5</b>	<b>2291</b>
<b>IA DNR</b>	<b>14</b>	<b>770</b>
<b>Total</b>	<b>27 Employees</b>	<b>4732 traps</b>

DNR hired five contractors that were paid by the number of traps they set-up (\$7/ trap) and took down (\$5/ trap). If 95% of the traps were placed in the correct locations the contractor was rewarded an additional \$3/ trap. This gave the contractors an incentive to do the work properly, yet gave them the flexibility to do the work on their own schedule.

In 2008 the natural spread of male gypsy moths into northeast Iowa resulted in the highest number of moths caught in Iowa history (626). Populations have been building in neighboring Adams, Columbia, Dane, Marathon and Sauk counties in Wisconsin over the past couple of years combined with good weather conditions this year, allowing for the movement of more male gypsy moths into one of Iowa’s most heavily forested areas. Because no egg masses have been found there are no treatments planned in Iowa for 2009. There will be additional traps placed around the positive catches for 2009.

This year, Iowa will be working with the USDA Slow the Spread Foundation to start trapping in Allamakee, Clayton, Delaware, Dubuque, Jackson, and Clinton Counties. Using the STS calculations, 2,500 traps will be setup in those counties alone while maintain approximately 4,000 traps outside the STS zone. Within the STS zone in Iowa, two areas were identified to start some delimit trapping.



## The STS Program

### *Slowing the Spread of Gypsy Moth to Protect America's Hardwood Forests*



#### **The Threat**

Gypsy moth is a destructive, exotic forest pest that was accidentally introduced into the United States in 1869. It is currently established throughout the northeast and parts of the upper mid-west (red shaded area on maps).

- It feeds on over 300 species of trees but oaks are most preferred.
- 77 million acres have been defoliated by gypsy moth since 1970.
- Gypsy moth defoliation causes extensive tree mortality, reduces property values, adversely affects commerce and causes allergic reactions in sensitive individuals that come in contact with the caterpillars.
- Most (almost 70%) of the susceptible hardwood forests in the United States have not been infested by gypsy moth and are still at risk.

#### **The Current Proactive Strategy**

Since Congress funded the Slow the Spread Program (STS) in the year 2000, ten states located along the leading edge of gypsy moth populations, in cooperation with the USDA Forest Service, have implemented a region-wide strategy to minimize the rate at which gypsy moth spreads into uninfested areas. As a direct result of this program, spread has been dramatically reduced by

more than 70% from the historical level of 13 miles per year to 3 miles per year. In just 8 years, this program has prevented the impacts that would have occurred on more than 75 million newly infested acres.

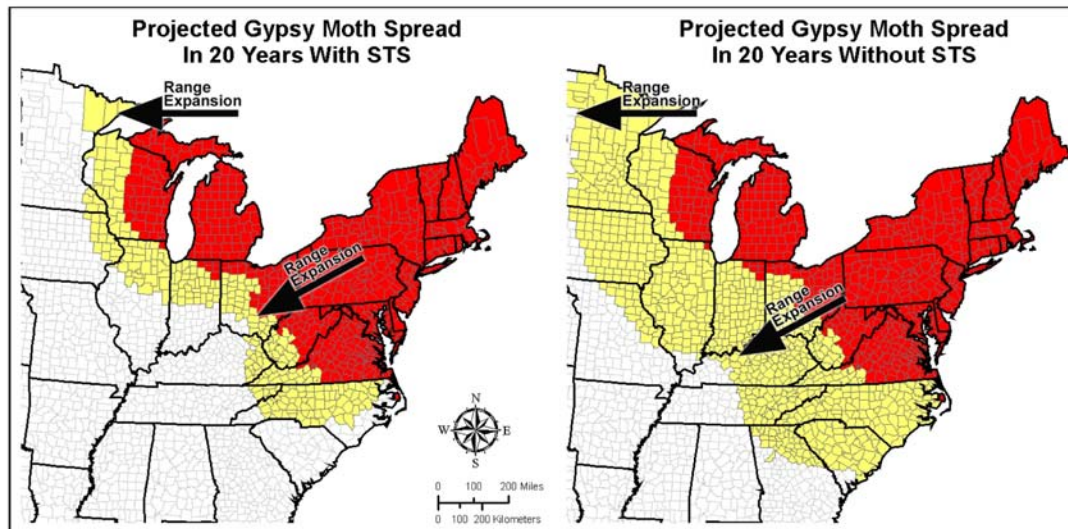
#### **The Benefits**

- STS reduces spread of this destructive pest to 3 miles per year, which will prevent infestation of more than 170 million acres over the next 20 years (compare maps).
- STS protects the extensive urban and wildland hardwood forests in the south and upper mid-west.
- STS protects the environment through the use of gypsy moth specific treatment tactics.
- STS unifies the partners and promotes a well coordinated, region-wide action based on biological need.
- STS yields a benefit to cost ratio of almost 3 to 1 by delaying the onset of impacts that occur as gypsy moth invades new areas.

#### **The Funding**

These benefits have been achieved with a partnership investment of state and federal funds ranging from \$11 million to \$13 million annually. Since its inception, the USDA Forest Service has supported the STS program as follows:

Year	2000	2001	2002	2003	2004	2005	2006	2007
Dollars (in millions)	\$8.0	\$8.3	\$10.0	\$10.9	\$11.0	\$10.0	\$9.9	\$8.25



Red shaded counties are infested as of 2007; yellow shaded counties will become infested over the next 20 years.

March 2008

## Tubakia

This disease has been found on bur oak trees over the past 4 years in Iowa. It shows up in late July or August showing discolored leaves especially along the interveinal tissue. It was reported by homeowners throughout Western and Central Iowa and seems to become less numerous as you go east across Iowa.

In an effort to better understand the impact this disease is having on bur oaks each year, permanent monitoring plots were established in 2007 at Loess Hills State Forest, Gull Point State Park and Thomas Mitchell Park in Polk county. Trees were mapped, rated for severity of infection, digital pictures were taken showing the condition of each tree and notes were taken about the presence of new leaves flushing as a result of this infection. Leaves were collected from each tree that was documented and bagged separately for the ISU Plant Insect Lab to diagnose what was causing the leaf discoloration. All the samples tested positive for Tubakia and negative for bacterial leaf scorch. Tubakia is generally not a problem to the health of a tree, unless repeated infection occurs on the same tree several years in a row. This could lead to the decline of trees with limited starch reserves.

Pictured below are sample leaves with typical signs of tubakia on a bur oak leaf.



Pictured below are trees with typical signs of tubakia on them. Notice a dead tree to the left, an infected tree in the middle and a healthy bur oak tree to the right. Is this disease causing the decline of these bur oak trees over time? A question we hope to answer in the upcoming years.



Pictured below is a bur oak tree that is re-leaving in August at Gull Point State Park. The concern about these trees using stored starch reserves at the end of the growing season is a concern to foresters because of how this will affect the health of that tree.



During the 2008 season, samples from the established plots were sent to Dr. Tom Harrington at Iowa State University for genetic analysis. Here are his findings to date: Based on DNA sequence analyses and morphology of cultures, the Tubakia species that is consistently associated with blighted bur oak trees in Iowa is distinct from two other species we have found: a common leaf-spot fungus on red oak and another leaf-spot fungus found on an ornamental white oak on the ISU campus. The red oak fungus is probably the commonly reported Tubakia leaf spot fungus in eastern North America. We found the red oak Tubakia on a single bur oak tree, though this tree was not seriously affected, and leaves on only a few twigs were symptomatic.

The Tubakia species associated with bur oak blight apparently moves into twigs and branches as an endophyte and can probably overwinter in the host in this manner. This might explain how the leaf symptoms tend to be uniform across affected branches and often uniform throughout the entire crown in the most seriously affected trees. Trees seriously affected one year tend to be severely affected the next year, and leaves of affected trees may be colonized by the fungus even before leaf symptoms appear in late July.

The Tubakia causing blight on bur oak was confirmed on post oak in Missouri (Tom Harrington, 2008). Further research is needed to understand this fungal blight.

## **Sudden Oak Death**

*Phytophthora ramorum* is the cause of the disease known as sudden oak death (SOD), ramorum leaf blight, and ramorum dieback. It is a non-native disease that was discovered in California in 2000. This pathogen has the potential to infect oaks and other trees and shrubs. For the latest information and a background of host species for this disease, visit [www.suddenoakdeath.org](http://www.suddenoakdeath.org).

The reason Iowa is monitoring for *Phytophthora ramorum* is because it is a quarantine pest and it may have been inadvertently introduced to all states outside the regulated areas of CA and OR on infested nursery stock in 2003-04 and again in separate incidents in 2004-05.

The Iowa Department of Natural Resources (IDNR) did not survey for this in 2008 because there have not been any positive finds in the Midwest. Map 1 in Appendix D shows all the sites surveyed for this disease in Iowa from 2003-2005.

Plant disease personnel are still studying whether this disease could exist on oak in Iowa and be able to withstand the winters. Iowa is not in the lowest risk category for this disease to become established, but is one level higher.



## Tatters Study in Iowa

Leaf tatters affects the leaves of trees causing them to look deformed or “tattered”. It causes newly emerged leaves to have reduced interveinal leaf tissue as the leaves grow larger. Tatters was first reported in Iowa, Indiana, and Ohio in the 1980’s and more recently in Wisconsin and Minnesota. Tatters has been reported on trees of all ages in rural and urban environments.

Not all trees become tattered because the leaves have to be exposed to the correct conditions after the leaves have emerged from their buds. The beginning stage of tatters is a curling of the young succulent white oak.

Foresters have not found insects or diseases when reviewing the damage caused by tatters. Current belief for the cause of tatters centers on environmental conditions that are causing farm chemicals to be moved off site and onto the leaves of trees.

A study done in a lab at the University of Illinois in 2004 - 2006 has reproduced the same damage that tatters causes to oak leaves by directly applying a chemical called acetochlor at 1/100 rate during the leaf emergence phase on white and red oak trees. For a complete report on what the Illinois study has found visit their web site:  
[http://www.nres.uiuc.edu/research/herbicide\\_research/index.htm](http://www.nres.uiuc.edu/research/herbicide_research/index.htm)

Here in Iowa, IDNR and the U of I Hygiene laboratory decided to collect 14 air, 12 rain water, and 15 oak leaves during a six week period of time to see how the levels of acetochlor varied in relation to the tatters event that was happening. Two urban sites were set-up with these collection stations. The Forestry Bureau has not yet received the results of the study.

In addition, the IDNR and ISU started a cooperative effort to help determine what chemicals could be causing oak tatters in Iowa. A total of 720 white oak seedlings were planted to be treated with six different treatments. The trees were treated with Acetachlor (300g {1/10 application rate}, 30g {1/100 application rate }, and 3g {1/1000 application rate}), Chlorine (5 ppm), 2-4D, and water. There were 120 trees in each treatment.

As expected the control, water, did not have any visual effects. Chlorine did caused the leaves to purple for about two weeks before starting to green up again. Then 2-4D completely killed the leaf material on the trees that were treated at bud break, and discolored and cupped the leaves that were expanding. The trees treated with 2-4D started to reflush with new growth within one month. The new growth did not show any signs of damage from the 2-4D. Acetachlor caused tatters at all levels. The 1/1000 application rate had minimal tattering on the leaves that were expanded, but did cause tattering on the trees that were just breaking bud.



Tatters from 1/10<sup>th</sup> application rate Acetachlor.



Tatters from 1/10<sup>th</sup> Acetachlor application rate at bud break.



Tatters from 1/10<sup>th</sup> Acetachlor application rate, leaf tissue separating out and gone within two weeks of treatment.



Cupping and discoloration of leaves prior to tattering treated with Acetachlor rate of 1/100<sup>th</sup>. Leaves treated at bud break.





Purpling from chlorine treatment.



Cupping from 2-4D treatments.

## Pine Shoot Beetle

The pine shoot beetle (*Tomicus piniperda* L.) is an introduced pest of pines. It was first discovered in the US at a Christmas tree farm near Cleveland, Ohio, in July 1992. A native of Europe, the beetle attacks new shoots of pine trees, stunting the growth of the trees. The pine shoot beetle may also attack stressed pine trees by breeding under the bark at the base of the trees. The beetles can cause severe decline in the health of the trees, and in some cases, kill the trees when high populations exist.

In May, 2006, USDA-APHIS-PPQ confirmed the presence of pine shoot beetle (PSB) in Dubuque and Scott counties. A Federal Order was issued effective June 22, 2006 placing Dubuque and Scott counties under a Federal quarantine for interstate movement of PSB regulated articles. Iowa Department of Agriculture and Land Stewardship (IDALS) was provided a copy of the Federal Order as well as additional information concerning the pine shoot beetle, and was requested to consider placing a state PSB quarantine for intrastate movement of PSB regulated articles from Dubuque and Scott Counties. However, after considerable review, IDALS declined to implement an intra-state quarantine for PSB. Therefore, a Federal Order was issued effective September 18, 2006 for quarantine of the entire state of Iowa for PSB, *Tomicus piniperda*.

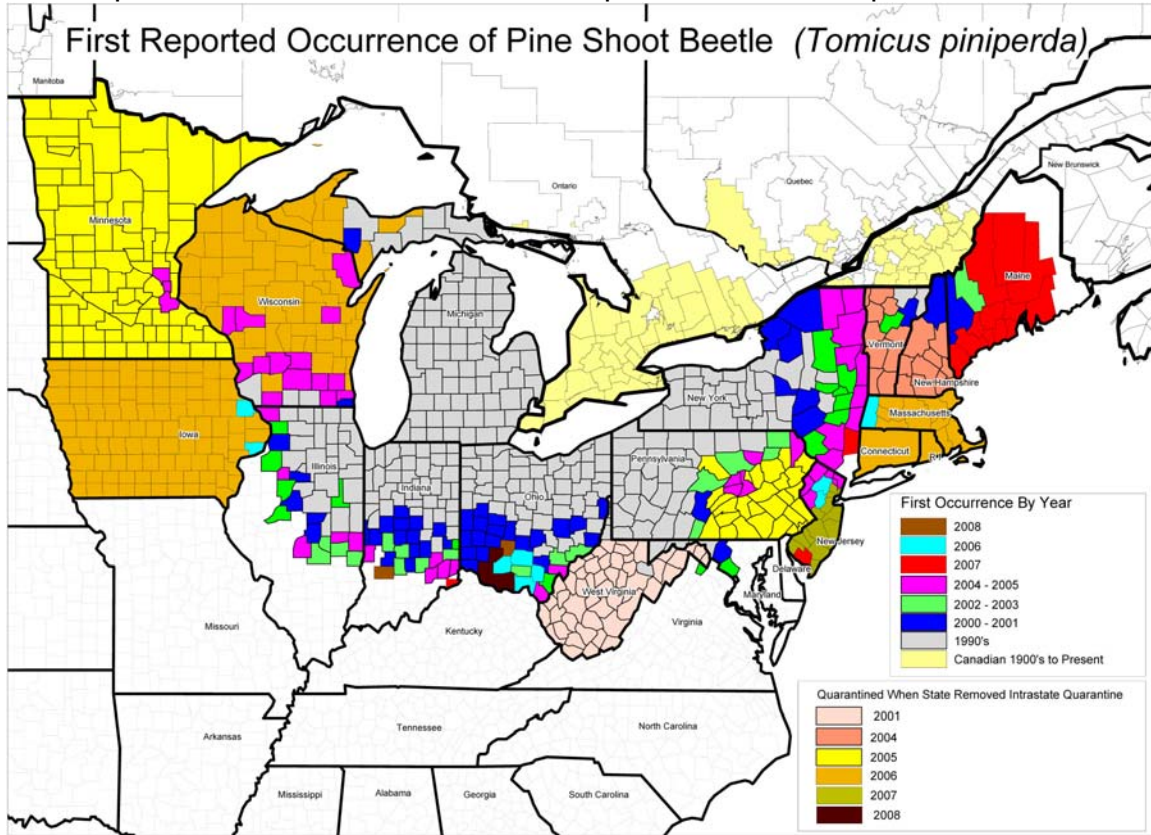
The quarantine affects the following pine products, called “regulated articles”:

- Pine nursery stock
- Pine Christmas trees
- Wreaths and garlands
- Pine logs/lumber (with bark attached)

All pine nursery stock shipped from Iowa to a non-regulated state must be inspected and certified free from PSB. This inspection and certification must occur just before shipping. Small pine seedlings (less than 36 inches tall, and 1 inch in diameter) and greenhouse grown pines require a general inspection of the

whole shipment. All other (larger) pine nursery stock shipments must have 100% tip-by-tip inspection.

The map below shows the areas that are quarantined for the pine shoot beetle.



As a result of this quarantine there are restrictions on nursery stock producers and Christmas tree growers.

### Nursery Growers

- Pine nursery stock and other pine regulated articles produced in Iowa, and other PSB-quarantined areas can move freely among the quarantine areas, barring other state-required phytosanitary and plant pest regulations.
- Pine nursery stock (and other regulated articles) growers AND distributors wishing to ship regulated articles outside of Iowa must contact USDA, APHIS, PPQ, Des Moines, 515-285-7044, as soon as possible to make arrangements for inspections, and possibly enactment of compliance agreements, to ensure that seamless shipping activities can occur this shipping season.
- Pine nursery stock and other regulated articles produced outside the quarantine area, moved into Iowa and then out to a non-quarantined final destination, are also subject to quarantined requirements, as if they had originated from a quarantined area.

## **Christmas Tree Growers**

- Christmas trees, wreaths, garlands and other pine regulated articles produced in Iowa, and other PSB-quarantined areas can move freely among the quarantine areas, barring other state-required phytosanitary and plant pest regulations.
- Growers of Christmas trees and other regulated articles AND distributors wishing to ship regulated articles outside of Iowa must contact USDA, APHIS, PPQ, Des Moines, 515-285-7044, as soon as possible to make arrangements for inspections, and possibly enactment of compliance agreements, to ensure that seamless shipping activities can occur this shipping season.
- Christmas trees, wreaths, garlands and other pine regulated articles produced outside the quarantine area, moved into Iowa and then out to a non-quarantined final destination, are also subject to quarantined requirements, as if they had originated from a quarantined area.

For more information on the biology of PSB, a description of the insect, and symptoms on trees, review this website at:  
<http://www.aphis.usda.gov/ppq/ispm/psb/>

If you suspect that you have PSB, you may collect a sample and send it to USDA, APHIS, PPQ, 6000 Fleur Dr., Des Moines, IA 50321, or contact USDA-APHIS-PPQ at 515-285-7044. If you think that you will be shipping out of the quarantine area, contact USDA-APHIS-PPQ at 515-285-7044 to set up an appointment to have your facility inspected for PSB.

PSB has only been detected in Scott and Dubuque Counties, however the whole state is under federal quarantine, in response to the decision made by the State of Iowa Department of Agriculture that an intrastate quarantine will not be implemented. Without an intrastate quarantine, USDA must assume that PSB is spreading to other Iowa counties and thus place a quarantine on the entire state, which restricts the movement of all regulated articles such as Pine nursery stock, Pine Christmas trees, Wreaths and garlands, Pine logs/lumber (with bark attached) into non regulated areas.

Additional information on the pine shoot beetle, such as background information, biology, regulations, fact sheets, federal orders, quarantine maps, etc.

USDA's main website for Pine shoot beetle is:

<http://www.aphis.usda.gov/ppq/ispm/psb/>

Fact Sheet

[http://www.aphis.usda.gov/lpa/pubs/fsheet\\_faq\\_notice/fs\\_phpsb.html](http://www.aphis.usda.gov/lpa/pubs/fsheet_faq_notice/fs_phpsb.html)

Federal Order for Iowa

<http://www.aphis.usda.gov/ppq/ispm/psb/regs.html>

Federal Regulations for PSB

<http://www.aphis.usda.gov/ppq/ispm/psb/psbcfr06.txt>

PSB Quarantine Map

<http://www.aphis.usda.gov/ppq/maps/psbquarantine.pdf>

## Hickory Mortality

Hickory decline, particularly of bitternut hickory and shagbark to a lesser extent, has recently been noted in Iowa (Johnson et al. 2005), in Missouri, Maryland, New York, Pennsylvania and West Virginia by FHM (USDA Forest Service 2003 and 2004), and Wisconsin (Wisconsin DNR, 2005). Widespread mortality of hickory has historically been attributed to outbreaks of the hickory bark beetle (*Scolytus quadrispinosus*) during extended periods of drought (USDA Forest Service 1985). The insect is considered the most important pest of the species group (Solomon and Payne, 1986). In



Dead and dying bitternut hickory in Carley State Park, Minnesota, August 2006.

1994, a newly discovered fungus was reported in discolored wood and sunken bark cankers associated with beetle attacks (USDA Forest Service, 1994). This fungus, *Ceratocystis smalleyi*, and a new sister species (*C. caryae*) were recently described (Johnson et al. 2005). Both species were pathogenic on 2-y-old *Carya* spp. in greenhouse studies. The researchers suggested that *C. smalleyi* might play a significant role in hickory mortality. Past land use and soil fertility were shown to indirectly determine outbreaks of the bark beetle (Dale, et al. 1990). Phomopsis galls, *Armillaria* root rot and a flatheaded woodborer (*A. otiosus*) have also been associated with declining trees (Wisc. DNR 2005). A re-examination of affected ecosystems is needed to determine and/or clarify the importance of hickory decline and mortality in relation to these damaging agents as well as climatic, edaphic and cultural factors.

Hickories are an important component of many forest associations in the eastern United States, particularly various oak-hickory cover types. Sites impacted by hickory decline and mortality have been reported to lose a high proportion of the hickory over a very short period of time (3 to 5 years), causing a significant adverse impact to wildlife, timber value and diversity on the sites.

Multiple decline-affected stands in at least six states will be identified by state cooperators for evaluation. Information on site history, stand and site conditions, and recent episodes of drought or other stresses will be recorded. Standard tree and stand information such as tree size class, area of stand, species present, will be recorded for each site. Transect survey methodology will be used to obtain estimates of decline and mortality frequencies. One to two trees in several decline foci will be closely examined for evidence of insect pest and/or damage

presence, and for disease damage and/or pathogen presence. Samples were collected and forwarded to the processing lab for insect pest identification or rearing plus identification and for pathogen isolation and identification. Relationships between i) insect pest and/or pathogen presence; ii) historical site and climate information; and iii) soils and stand condition information and decline and mortality frequencies were investigated.

Year 1 Role of *Ceratocystis* species – A) Field and laboratory studies were conducted in selected stands with active hickory decline to determine the role of *Ceratocystis* spp. in tree decline and mortality. i) Isolations will be attempted from hickories with and without a) hickory bark beetle colonization, b) *Agrilus* spp. colonization, and c) open wounds, to determine the frequencies of *C. smalleyi* and *C. caryae* associated with each. B) Field inoculations of apparently healthy pole-sized trees of the predominant hickory species will be inoculated with isolates of both *Ceratocystis* species to confirm pathogenicity suggested by seedling tests (Johnson et al. 2005) and to investigate whether systemic spread of the organisms occur within infected trees. C) The contamination frequency of hickory bark beetles with *C. smalleyi* dispersing in the stand and/or emerging from colonized trees will be determined.

Year 2 (activities remaining) – i) purify and identify fungal isolates obtained from cankered stems of logs sampled during 2008 survey, ii) finish identification of collected insects and record numbers of each species obtained, iii) summarize and analyze results of 2008 field surveys, and iv) conduct preliminary statistical analyses on relationship between hickory condition and stand site factors. Year 3 (planned) – i) conduct several additional field evaluations in Indiana (2), Iowa (2) and Ohio (1) if suitable sites are located, ii) set up replication of field experiment attempting to reproduce decline symptoms in tree crowns of healthy bitternut, iii) set up replication of field experiment investigating relationship between presence of diffuse canker fungus and associated sapwood colonization with disrupted xylem functioning, and iv) determine frequency of *C. smalleyi* and diffuse canker presence with hickory bark beetle attacks for two additional trees, and v) determine the frequencies of hickory bark beetles emerging from declining hickory and carrying viable *Ceratocystis* spp. propagules.

Site, tree, insect and pathogen data were collected for 11 sites with reported hickory decline and mortality in Indiana, New York, Ohio and Wisconsin between 27 May and 25 June 2008. Stem sections collected from three trees felled in each site were processed in the laboratory and greenhouse. Insects emerging from log sections in emergence tubes were collected weekly over a 50 day time period. Attempts to isolate causal fungi from observed stem galls or cankers were completed. Counts of collected insect species are underway. Purification and identification of fungal isolates are also underway. *Preliminary Findings* – 1) Bitternut hickory dying in 1 to 2 years is attributed to hickory bark beetle attack and colonization and, potentially, xylem functioning impairment caused by *Ceratocystis smalleyi*., 2) Hickory dieback, where a major fork or top main stem

is killed, is often due to very numerous annual cankers often caused by *Fusarium solani*., 3) Hickory bark beetles accounted for 91% of emerged insects from 2008 survey samples and hickory timber beetles accounted for 8%., 4) Diffuse cankers, sometimes with bleeding, and discolored sapwood were commonly found., 5) Perithecia and isolates of *Ceratocystis* sp. were obtained from diffuse cankers on trees in five stands in New York, one stand in Ohio, and 1 stand in Indiana. If the isolates are confirmed as *C. smalleyi*, these results will greatly expand the known range of the pathogen.

The second and final evaluation of the preliminary study on the relative ability of putative hickory stem canker fungi to contribute to decline of bitternut hickory was completed. Collected datasets were summarized and analyzed as appropriate. *Ceratocystis smalleyi* was identified as the species most likely to contribute to hickory decline. A scientific poster presentation of these results was delivered at the 2008 annual meeting of the American Phytopathological Society. Three additional field experiments were initiated in summer 2008. The studies are designed to further evaluate the role of this fungus in disrupting normal tree functioning and its ability to cause crown decline.

### **Summary**

In a field trial involving inoculation of pole-size bitternut hickory, cankers and sapwood discoloration associated with two *C. smalleyi* isolates were at least two times larger than bark necrosis associated with isolates of *C. caryae* and *F. solani* as well as the sterile agar control. Thus, *C. smalleyi* is the species most likely to contribute to bitternut decline and death. (Jenny Juzwik, 2008 Report)



## INVASIVE PLANT SPECIES

Invasive species are plants that are non-native to an ecosystem and cause or are likely to cause economic or environmental harm to humans, crops, livestock or natural plant and animal communities. Some examples of non-native species found to be a problem in Iowa forests are buckthorn, garlic mustard, honeysuckle and multiflora rose. These invasive and exotic plants are out competing native forest species, diminishing fisheries and wildlife habitat, reducing water quality, reducing economic returns from forest management and tourism, and threaten long term forest sustainability and bio-diversity. A list of invasive plants known to exist in Iowa is provided in a table located in Appendix E.

A website facilitating the training and participation of volunteers, public educational and outreach efforts, for the entry and management of volunteer generated data for Iowa have been created. The website is [http://www.nrem.iastate.edu/Invasive\\_Species/Invasives.html](http://www.nrem.iastate.edu/Invasive_Species/Invasives.html).

The Forestry Bureau is committed to developing better awareness about invasive species and their presence on both public and private lands. The Forestry Bureau works with MIPN, a regional group consisting of natural resource professionals employed by public and private organizations that are monitoring for invasive plants in the Midwest. Visit the MIPN website at [www.MIPN.org](http://www.MIPN.org) for more detailed information on prevention and management strategies for invasive plants.

Additional web resources for learning about invasive species are:

- Center for Invasive Plant Management- [www.weedcenter.org](http://www.weedcenter.org) > Invasive Plant Management on-line textbook
- National Invasive Species Information Center- [www.invasivespeciesinfo.gov](http://www.invasivespeciesinfo.gov)
- USDA-APHIS web site- [www.invasive.org](http://www.invasive.org)
- Forest Service web site: [www.na.fs.fed.us/fhp/invasive\\_plants/links/index.shtm](http://www.na.fs.fed.us/fhp/invasive_plants/links/index.shtm)
- Natural Resource Conservation Service web site: <http://plants.usda.gov>
- Woodland invasive species in Iowa brochure produced by Iowa State University- <https://www.extension.iastate.edu/store/ItemDetail.aspx?ProductID=6497&SeriesCode=&CategoryID=&Keyword=invasive%20species>

## CONCLUSION

Management plays an important role in creating a healthy Iowa forest. The best insurance a person can have when managing their woodlands is diverse woodlands that have a goal oriented management plan. The best management plan for community forests is not have more than 10% of any one species represented. Iowa forests provide an important role by providing abundant forest products and amenities, including outdoor recreation opportunities, wildlife habitat, water quality, and the economic benefits of a vast array of wood and wood fiber products.

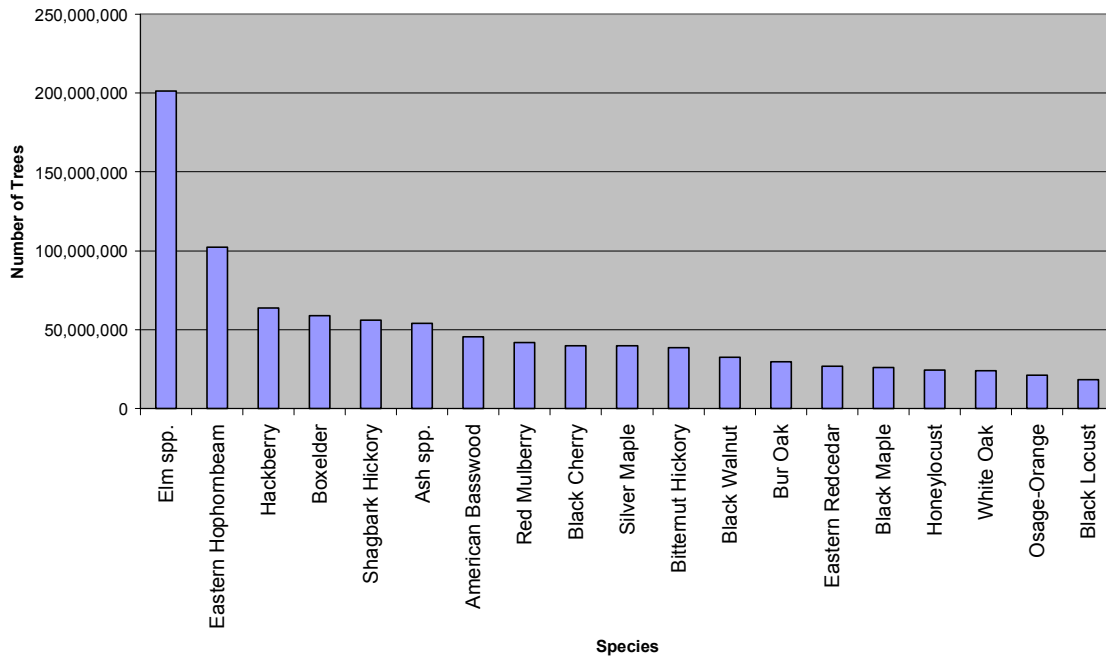
Future Iowa forests will be impacted by invasive species that are already establishing themselves in the woodland understory or are within a neighboring state. No longer will passive management allow for woodlands to be “preserved” in the condition they are in today. Learning about your woodlands and how each component affects another will make it easier for Iowa’s woodlands to be managed for long term health. If you need technical assistance with your woodlands contact your district forester for assistance at <http://www.iowadnr.gov/forestry/district.html>.

The Bureau of Forestry, through cooperation with other agencies has programs in place to monitor forest stressors which have potential to move into Iowa and damage our forests. Those programs operated vigorously during 2008, and plans are in place for similar, continued vigorous forest health program operations in 2009.

IDNR would like to thank its collaborators from USDA-APHIS-PPQ, Iowa State University Extension, Iowa Department of Agriculture and Land Stewardship, and Department of Natural Resources Foresters.

# Appendix A

## Number of Trees in Iowa on Forestland (FIA 2005)



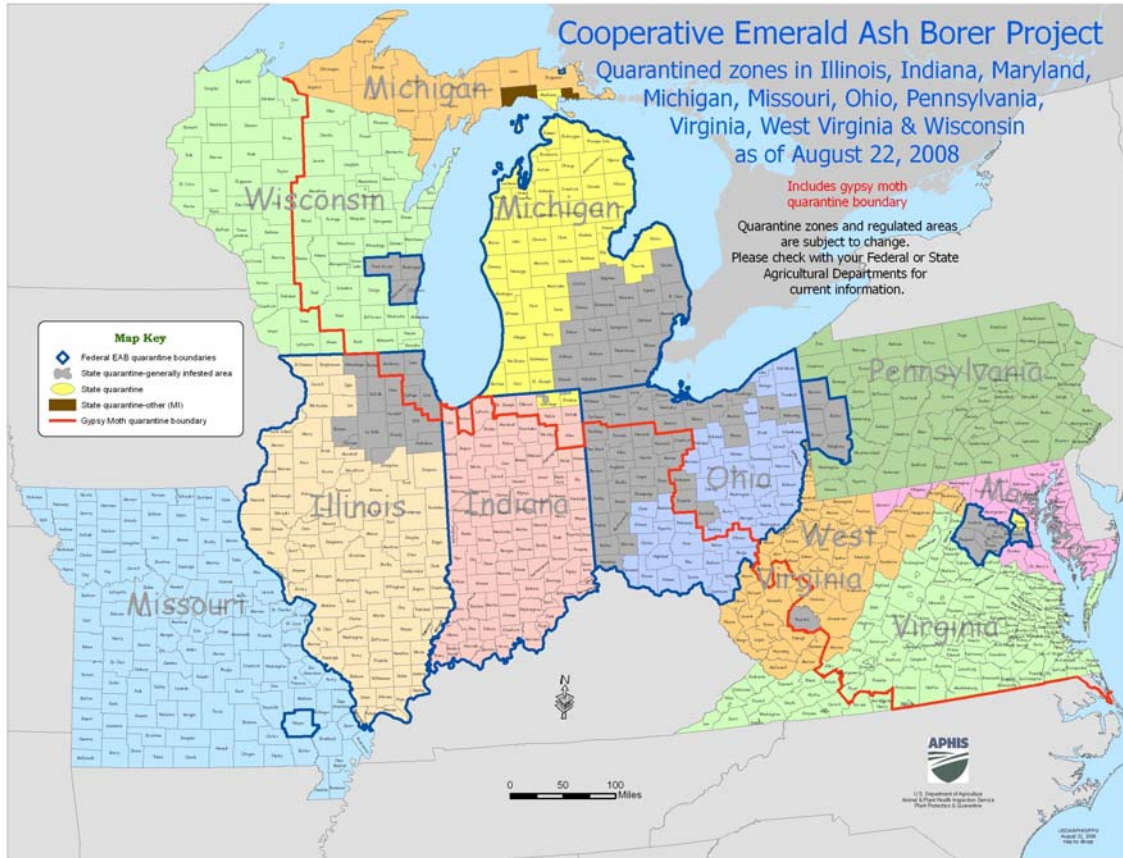
**Table 1. Iowa Tree Species Rankings based on the latest Forest Inventory Data (2005)** Note Green Color means these species went down from the 2004 inventory.

Species	Number of Trees (2005)	Ranking (2005)	Percentage of Iowa Forest
<b>Elm spp.</b>	201,140,824	1	<b>18.34%</b>
Eastern Hophornbeam	<b>102,291,361</b>	2	<b>9.33%</b>
Hackberry	63,899,030	3	<b>5.83%</b>
Boxelder	58,750,295	4	<b>5.36%</b>
Shagbark Hickory	55,977,690	5	<b>5.10%</b>
<b>Ash spp.</b>	<b>54,100,862</b>	6	<b>4.93%</b>
American Basswood	<b>45,509,927</b>	7	<b>4.15%</b>
Red Mulberry	41,738,128	8	<b>3.81%</b>
Black Cherry	39,754,839	9	<b>3.62%</b>
Silver Maple	39,693,734	10	<b>3.62%</b>
Bitternut Hickory	<b>38,701,546</b>	11	<b>3.53%</b>
<b>Black Walnut</b>	32,391,437	12	<b>2.95%</b>
<b>Bur Oak</b>	29,561,031	13	<b>2.70%</b>
Eastern Redcedar	26,725,567	14	<b>2.44%</b>
Black Maple	26,129,369	15	<b>2.38%</b>
Honeylocust	24,169,201	16	<b>2.20%</b>

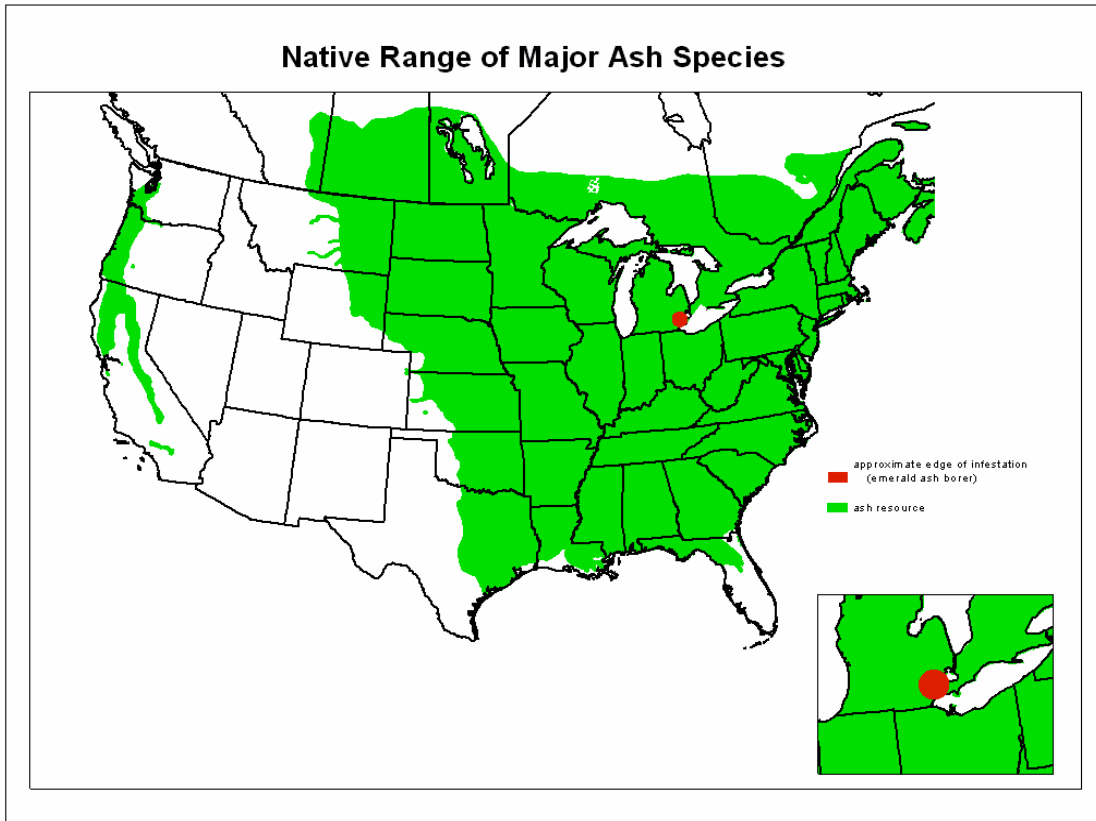
Species	Number of Trees (2005)	Ranking (2005)	Percentage of Iowa Forest
<b>White Oak</b>	<b>24,083,811</b>	17	<b>2.20%</b>
Osage-Orange	21,215,051	18	<b>1.93%</b>
Black Locust	18,361,701	19	<b>1.67%</b>
Sugar Maple	<b>17,844,181</b>	20	<b>1.63%</b>
<b>Northern Red Oak</b>	16,083,951	21	<b>1.47%</b>
Shingle Oak	<b>15,321,941</b>	22	<b>1.40%</b>
Black Willow	<b>14,831,230</b>	23	<b>1.35%</b>
Hawthorn	11,527,944	24	<b>1.05%</b>
Ohio Buckeye	10,863,849	25	<b>0.99%</b>
American Hornbeam	10,772,754	26	<b>0.98%</b>
Wild Plum	9,964,643	27	<b>0.91%</b>
Black Oak	<b>7,645,108</b>	28	<b>0.70%</b>
Eastern Cottonwood	6,675,187	29	<b>0.61%</b>
Serviceberry	<b>4,053,631</b>	30	<b>0.37%</b>
River Birch	3,669,320	31	<b>0.33%</b>
Eastern Redbud	<b>2,999,129</b>	32	<b>0.27%</b>
Chokecherry	<b>2,903,396</b>	33	<b>0.26%</b>
Northern Pin Oak	2,395,430	34	<b>0.22%</b>
Mockernut Hickory	<b>2,299,943</b>	35	<b>0.21%</b>
Quaking Aspen	2,011,588	36	<b>0.18%</b>
Paper Birch	1,809,194	37	<b>0.16%</b>
Chinkapin Oak	<b>1,203,518</b>	38	<b>0.11%</b>
Cockspur Hawthorn	<b>1,170,554</b>	39	<b>0.11%</b>
Bigtooth Aspen	<b>999,786</b>	40	<b>0.09%</b>
Swamp White Oak	965,486	41	<b>0.09%</b>
Sycamore	753,565	42	<b>0.07%</b>
Pin Oak	<b>667,678</b>	43	<b>0.06%</b>
<b>Butternut</b>	<b>658,964</b>	44	<b>0.06%</b>
Red Maple	<b>410,096</b>	45	<b>0.04%</b>
Ponderosa Pine	<b>285,926</b>	46	<b>0.03%</b>
Northern Catalpa	<b>239,799</b>	47	<b>0.02%</b>
Pignut Hickory	<b>200,746</b>	48	<b>0.02%</b>
White Willow	<b>175,227</b>	49	<b>0.02%</b>
Russian Olive	161,565	50	<b>0.01%</b>
Apple spp.	149,925	51	<b>0.01%</b>
Willow	<b>141,013</b>	52	<b>0.01%</b>
Post Oak	<b>120,266</b>	53	<b>0.01%</b>
Tamarack	<b>101,599</b>	54	<b>0.01%</b>
Red Pine	87,480	55	<b>0.01%</b>
White Mulberry	75,006	56	<b>0.01%</b>
Larch (Introduced)	74,538	57	<b>0.01%</b>
Ailanthus	40,767	58	<b>0.00%</b>
Downy Hawthorn	40,391	59	<b>0.00%</b>
White Pine	40,391	60	<b>0.00%</b>
Peach Leaf Willow	32,457	61	<b>0.00%</b>
<b>Scotch Pine</b>	32,457	62	<b>0.00%</b>
<b>Total Number of Trees</b>	<b>1,096,697,023</b>		

# Appendix B

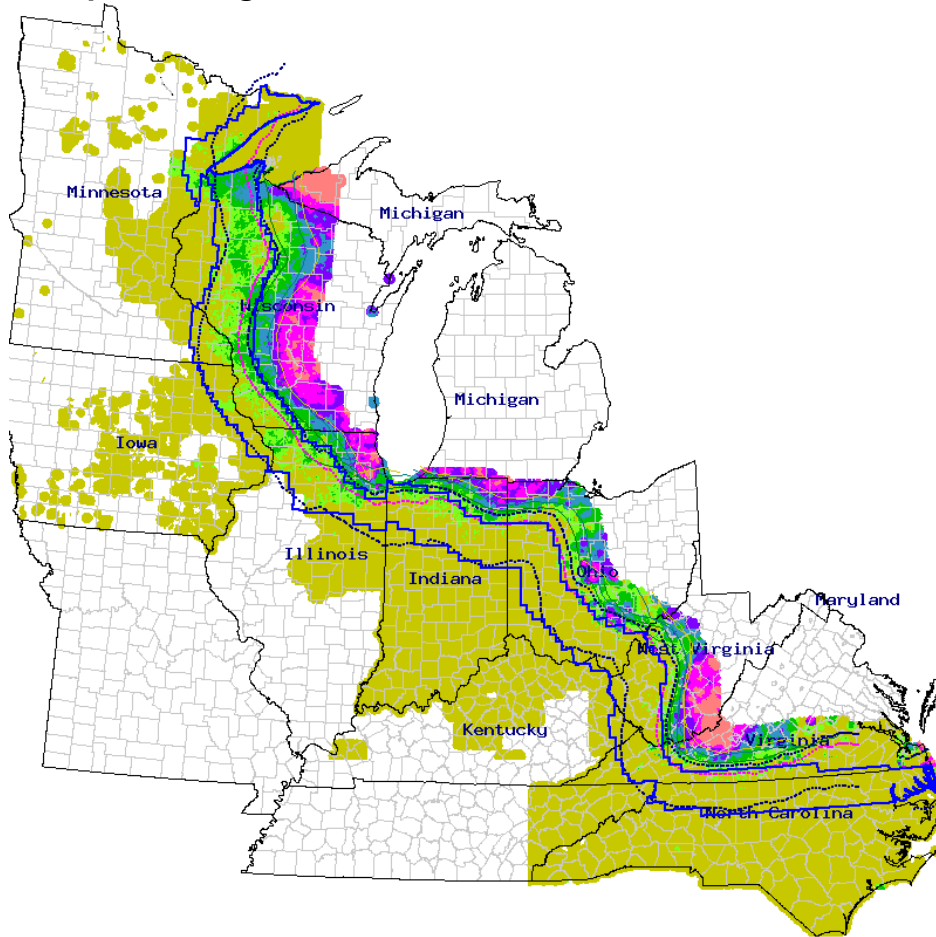
## Map 1. Current known Emerald Ash Borer sites as of January 2, 2008 in North America.



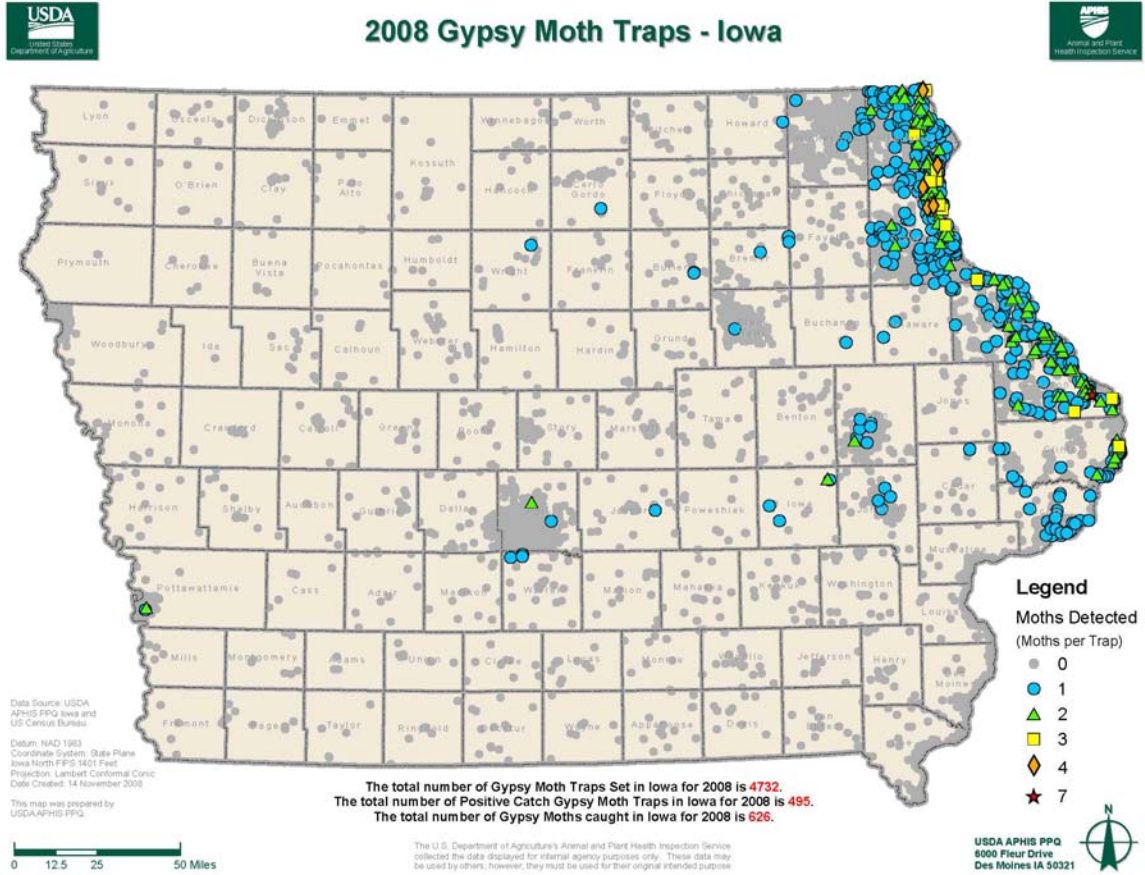
**Map 2. Distribution of Ash in the United States is highlighted in Green.**



**Map 1. Gypsy Moth Summary Map Showing Trap Catch Distribution Patterns and Where Male Moths were Caught in the Midwest. See Legend for color definitions. Note the Iowa counties that are now part of the Slow the Spread Program.**



## Map 2. Gypsy Moth Summary Map Showing Trap Distribution Patterns and Where Male Moths were Caught in Iowa.





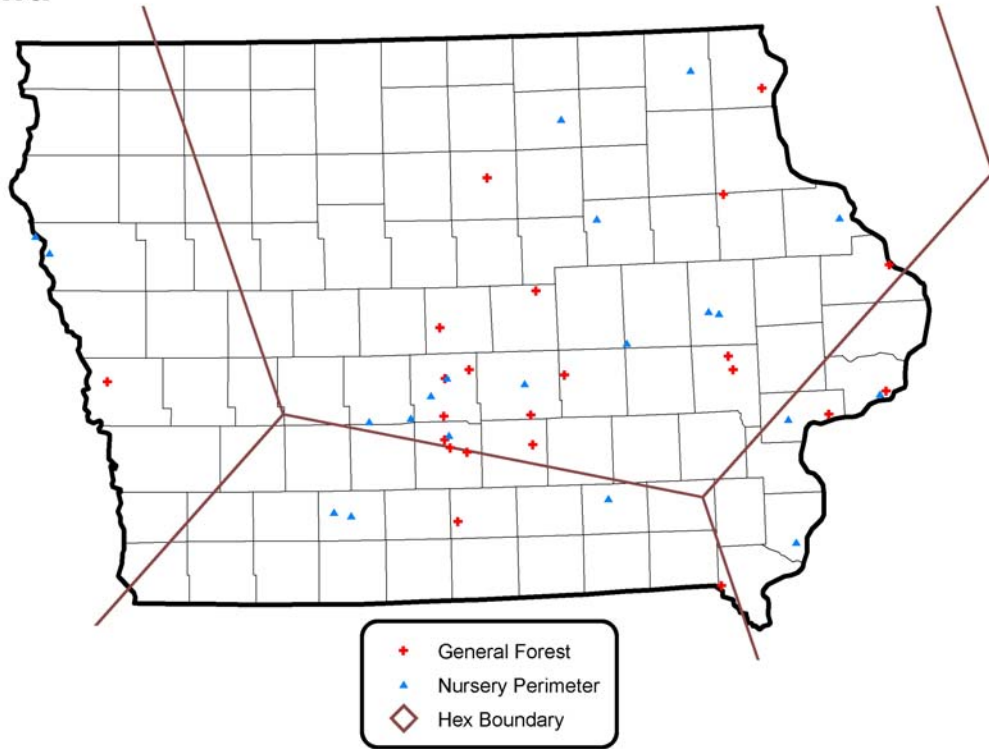
**Table 1: History of the Number of Gypsy Moth Catches and the Number of Acres Treated for gypsy moth eradication in Iowa (1972-2007). Unless specified, *Bacillus thuringiensis* var. *kurstaki* was the treatment method.**

Year	Number of Traps used in Survey	Number of Multiple Catches	Total Number of Moths Caught	Number of Acres Treated
1972	253		1	
1973	1196		0	
1974	1210		1	
1975	1120		0	
1976	1650		0	
1977	1130		0	
1978	741		1	
1979	854		0	
1980	676		1	
1981	970		6	
1982	1123		11	
1983	1617		14	
1984	3585		10	
1985	2538		6	
1986	3217		15	
1987	3084		18	
1988	2259		13	
1989	2858		27	9
1990	2760		17	0
1991	2775		61	0
1992	4738		162	21
1993	4800		72	73.5
1994	5797		143	90
1995	6324		76	52
1996	5241		104	25
1997	5899		151	10
1998	7093		371	21.3
1999	7532		135	224 (pheromone flakes)
2000	6834		47	42
2001	5729		26	15
2002	5729		35	2
2003	3068		159	3 (carbaryl)
2004	4374		27	26
2005	4996		4	0
2006	4891		20	0
2007	4900		175	0
2008	4732		626	0

# Appendix D

Map 1. Summary of Sites Surveyed for SOD in 2003-2005 for Iowa.

## Forest Survey Sites 2003 - 2005 Iowa



# Appendix E

## Known Invasive Plants in Iowa 2008

Key: NP= Not Present- Not known to exist in Iowa

I= Isolated- the species is infrequent, not commonly seen

LA= Locally Abundant- the species is present but is not in the majority of the counties

W= Widespread- commonly seen in the majority of counties in large or small populations

Species	Common Name	Abundance
<i>Abutilon theophrasti</i>	velvetleaf	W
<i>Ailanthus altissima</i>	tree-of-heaven	W
<i>Alliaria petiolata</i>	garlic mustard	LA
<i>Berberis thunbergii</i>	Japanese barberry	W
<i>Bromus tectorum</i>	cheatgrass	W
<i>Butomus umbellatus</i>	flowering rush	NP
<i>Carduus acanthoides</i>	plumeless thistle	I
<i>Carduus nutans</i>	Musk thistle	W
<i>Celastrus orbiculata</i>	Oriental bittersweet	I
<i>Centaurea maculosa/ biebersteinii</i>	spotted knapweed	LA
<i>Centaurea repens</i>	Russian knapweed	I
<i>Centaurea solstitialis</i>	yellow starthistle	I
<i>Cirsium arvense</i>	Canada thistle	W
<i>Cirsium</i> spp.	thistle	W
<i>Cirsium vulgare</i>	bull thistle	W
<i>Conium maculatum</i>	poison hemlock	I
<i>Coronilla varia</i>	crown vetch	W
<i>Daucus carota</i>	Queen Anne's lace	W
<i>Dipsacus fullonum/sylvestris</i>	common teasel	I
<i>Dipsacus laciniatus</i>	cutleaf teasel	I
<i>Dipsacus sativus</i>	Indian teasel	NP
<i>Elaeagnus angustifolia</i>	Russian olive	I
<i>Elaeagnus umbellata</i>	autumn olive	LA
<i>Euonymus alatus</i>	burning bush	I
<i>Euphorbia esula</i>	leafy spurge	W
<i>Fallopia japonica/ Polygonum cuspidatum</i>	Japanese knotweed	LA
<i>Frangula alnus/Rhamnus frangula</i>	glossy buckthorn	I
<i>Heracleum mantegazzianum</i>	giant hogweed	NP
<i>Hesperis matronalis</i>	dame's rocket	W
<i>Lespedeza cuneata</i>	Sericea lespedeza	I
<i>Ligustrum japonicum</i>	Japanese privet	NP
<i>Ligustrum obtusifolium</i>	blunt-leaved or border privet	I
<i>Ligustrum sinense</i>	Chinese privet	NP
<i>Ligustrum vulgare</i>	common or European privet	I
<i>Lonicera fragrantissima</i>	fragrant honeysuckle	NP
<i>Lonicera japonica</i>	Japanese honeysuckle	LA
<i>Lonicera maackii</i>	Amur honeysuckle	W

<b>Species</b>	<b>Common Name</b>	<b>Abundance</b>
<i>Lonicera morrowii</i>	Morrow's honeysuckle	I
<i>Lonicera standishii</i>	Standish's honeysuckle	NP
<i>Lonicera tatarica</i>	Tatarian honeysuckle	W
<i>Lonicera x bella</i>	Bell's honeysuckle	I
<i>Lonicera xylosteum</i>	European fly honeysuckle	NP
<i>Lythrum salicaria</i>	purple loosestrife	W
<i>Morus alba</i>	white mulberry	W
<i>Pastinaca sativa</i>	wild parsnip	W
<i>Potamogeton crispus</i>	curlyleaf pondweed	I
<i>Pueraria montana</i>	kudzu	I
<i>Rhamnus cathartica</i>	common buckthorn	W
<i>Rosa multiflora</i>	multiflora rose	W
<i>Tamarix spp.</i>	salt cedar	I