IOWA'S FOREST HEALTH REPORT, 2010

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Table of Contents

Aerial Survey	**Page 3**
Land Characteristics	**Page 5**
Emerald Ash Borer	**Page 10**
Gypsy Moth	**Page 21**
Bur Oak Blight	**Page 33**
Thousand Cankers Disease	**Page 40**
Forest Tent Caterpillar	**Page 46**
Oak Wilt	**Page 47**
Sudden Oak Death	**Page 48**
Oak Tatters	**Page 48**
Pine Shoot Beetle	**Page 51**
Hickory Decline	**Page 54**
Dutch Elm Disease	**Page 59**
Butternut Canker	**Page 61**
Invasive Plants	**Page 63**
Overall Conclusion	**Page 64**
Appendix	**Page 65**

Introduction

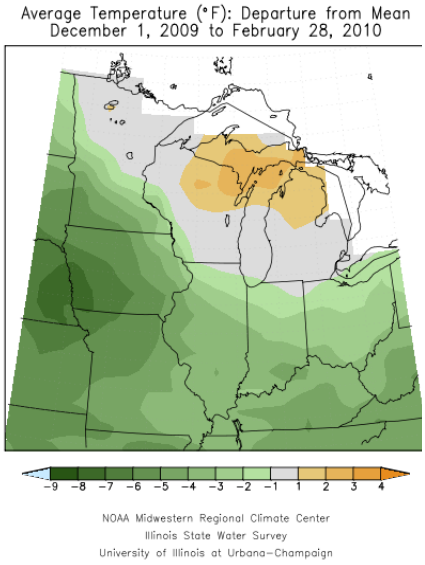
Each year the Iowa DNR Bureau of Forestry cooperates with numerous agencies to protect Iowa's forests from insects, diseases, and other damaging agents. These programs involve ground and aerial surveys, setting up sentinel trees, setting up pheromone traps, following transects for sampling, collecting 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.

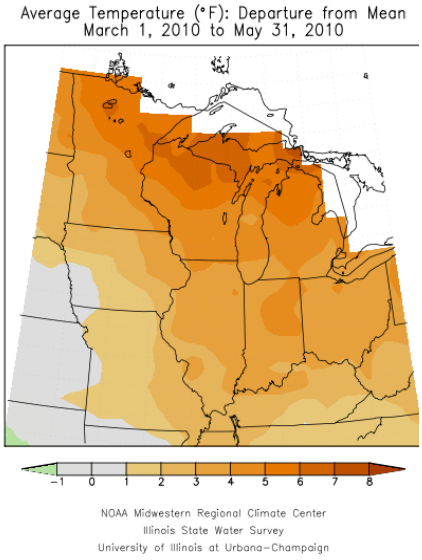
This year's report begins with a brief summary of weather events, Forest Service Inventory data for Iowa's forests, and several survey summaries for insects, diseases, and invasive plants that have the potential to impact Iowa's forests health. The 2010 surveys for exotics insects and diseases focused on Emerald Ash Borer, Bur Oak Blight, Thousand Cankers Disease, and Gypsy Moth. The potential economic loss caused by these four key pest could impact the State of Iowa by causing a 87.3 million dollars loss annually for wood industry and 4.3 billion in urban tree removal assuming these pest cause complete mortality to the species they impact. This report finishes up

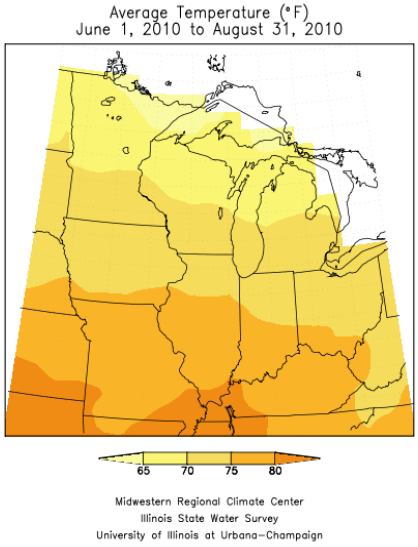
by describing forest insects and diseases already present, and concludes with invasive plant species in our forests.

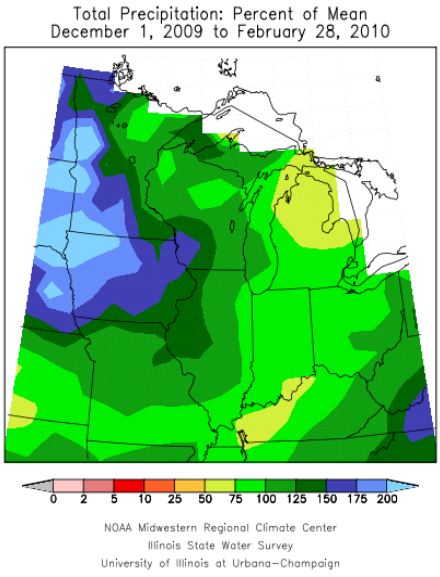
Weather

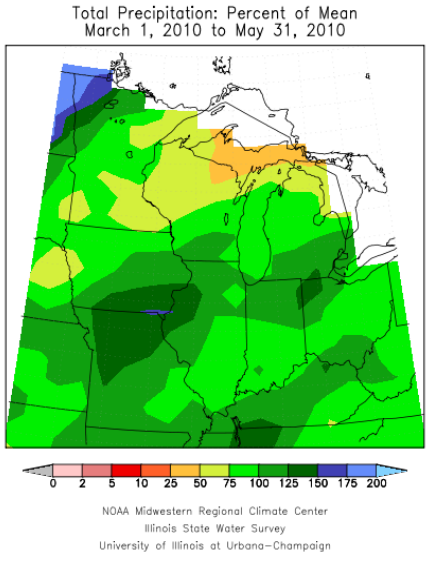
This winter did bring about many changes for Iowa with a heavier than normal snow load. The entire state experienced a much warmer than normal spring and summer; with most all of Iowa having heavier than expected rainfall events (see Figures below). The heavy rainfall events brought about chlorosis in 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 and a higher than normal amount of Anthracnose (a fungal leaf disease) on sycamore and maple throughout the state. Hackberry, maple, and sycamore trees produced a new flush of leaves within a few weeks as expected.

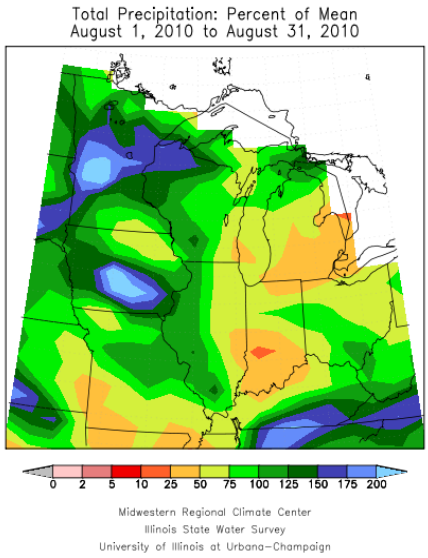






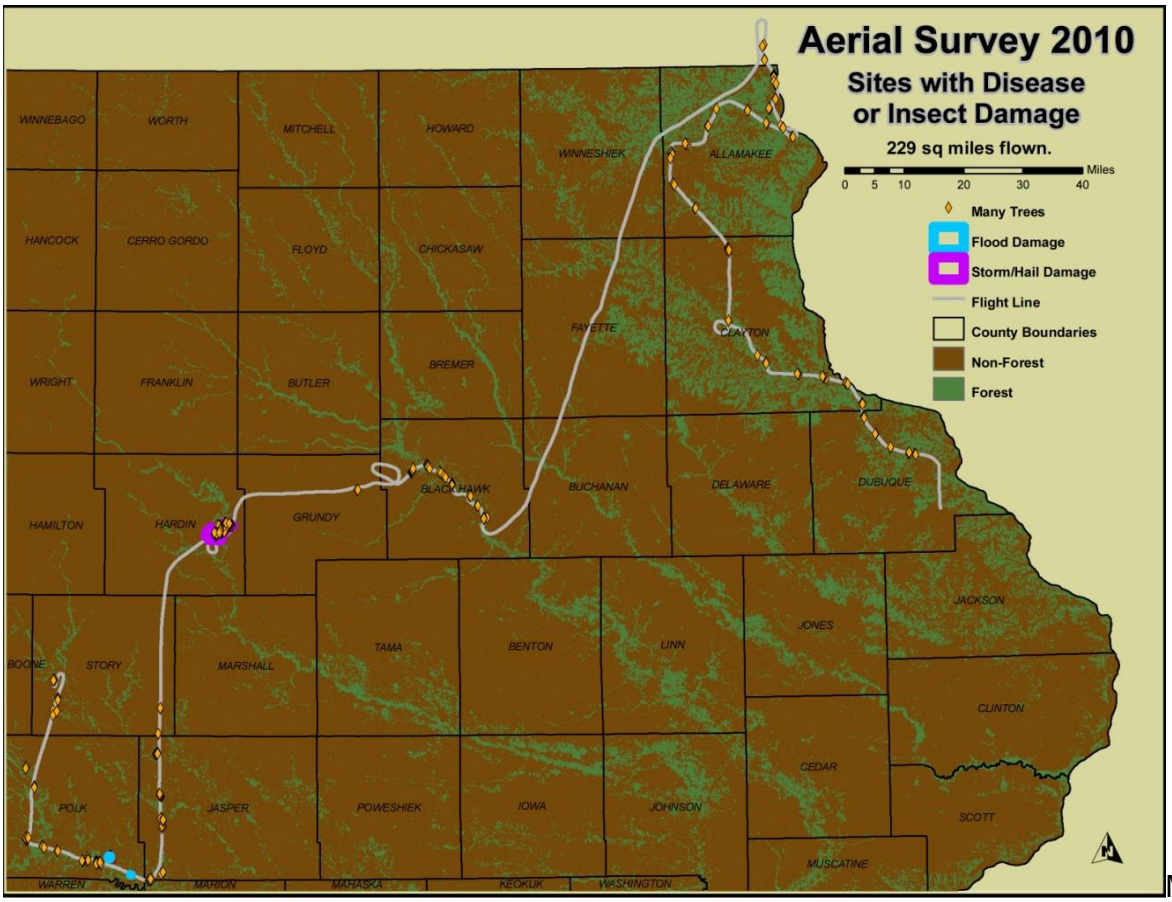






Aerial Survey

Iowa forests surveyed by plane in 2010 were found to be in generally good condition. On July 26, the surveying started above Ames, IA and flew south along the Iowa River, then flew north along the Iowa River, then went north to Yellow River State Forest following the Mississippi River south to Dubuque, IA. A total of 146,560 acres were surveyed. Silver maple and cottonwood trees throughout the state showed chlorotic 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 July. Scattered trees with lace bug damage were noticed throughout the state, with most of the damaged trees occurring in Eastern Iowa. The aerial flights found the same levels of Pine Wilt and Oak wilt that was noted in the 2009 aerial survey. In addition, the aerial flight continued to find large pockets of aspen continuing to decline in NE Iowa. The cause of the aspen decline is unknown at this time. The flight route showed tremendous damage (95% damage) from the hail and straight line winds that hit Hardin County in 2009. Many of the trees are severely damaged from the hail on the top of their branches and nearly all conifers lost their limbs from the hail storms. Signs of oak wilt were present in the area, and it is expected that numerous trees will not recover from the severe hail damage; most of which cannot be seen from the ground. The

pictures below show the severe damage to the conifers at Pine Lake State Park and some of the decline of the hardwoods.

The pictures of above detail the damage to the pines and other conifers from the hail damage. Nearly 95% of the conifers surveyed sustained severe damage and are declining or dead.

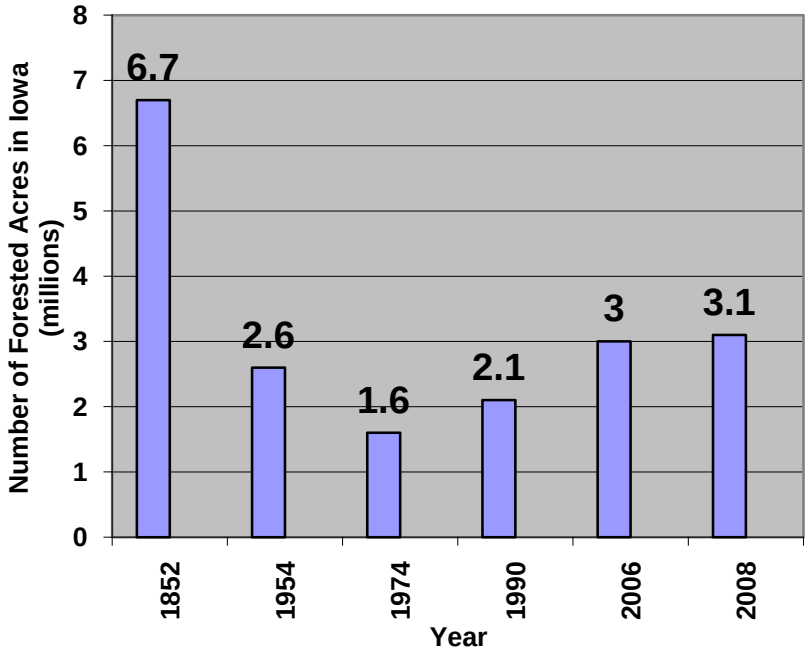
The picture above shows damage to pockets of conifers and several scattered oaks that had severe hail damage allowing oak wilt to be introduced to this site. Three oak trees tested positive for oak wilt (circled in red) on September 13, 2010 and will require some follow up to prevent further spread.

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 enhance the quality of life in Iowa for the citizen of Iowa.

Iowa has approximately 3.1 million acres of forested land representing a steady increase over the past few decades as shown in Figure 1 below. However, with the current economy, annual income from corn and soybean is more alluring than longer rotation crops (trees) causing many of the newly planted area shift back in the croplands and fewer applications for cost share programs. Most of Iowa's 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's 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 could 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 Figure 2 below.

Figure 2. Breakdown of 12 Most Common Iowa Forest Types by Size Class, 2008.

Forest Type	Acres in Large Diameter (2008)	Acres in Medium Diameter (2008)	Acres in Small Diameter (2008)
Redcedar/Hardwood	21,438	26,835	13,154
Sugar Maple	24,590	0	0
Hard Maple/Basswood	35,266	0	0
Cottonwood	76,253	8,337	17,789
Black Walnut	87,915	11,863	12,148
Elm/Ash/Locust	100,478	82,684	64,827
White Oak	127,414	8,069	0
Silver Maple/ American Elm	153,162	16,753	8,055
Hackberry/Elm/Green Ash	163,949	163,949	34,550
Bur Oak	185,075	14,447	1,701
Mixed Upland Hardwoods	258,282	155,028	72,286
White Oak/Red Oak/Hickory	578,150	117,091	83,250
Totals	**1,811,983**	**605,056**	**307,760**

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 eco-system is eliminated shade tolerant species like sugar maple, ironwood, elm, and bitternut hickory are in a position to fill the void.

Iowa's oak forests have a sporadic seed production and may only produce good seed crops once every 2-5 years. This makes the timing of silvicultural treatments or harvesting very important to the regeneration of oak stands. Another challenge for maintaining oak forests is localized heavy deer populations that eat oak seedlings and keep them browsed to a point where other less palatable species out compete the oak. Fragmentation of forest land into smaller tracts with houses near or in the timber make the management practices for oak less feasible for landowners, since they are not likely to commit to the intensity f management needed to regenerate oak. 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 and not a forest. Landowners 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.

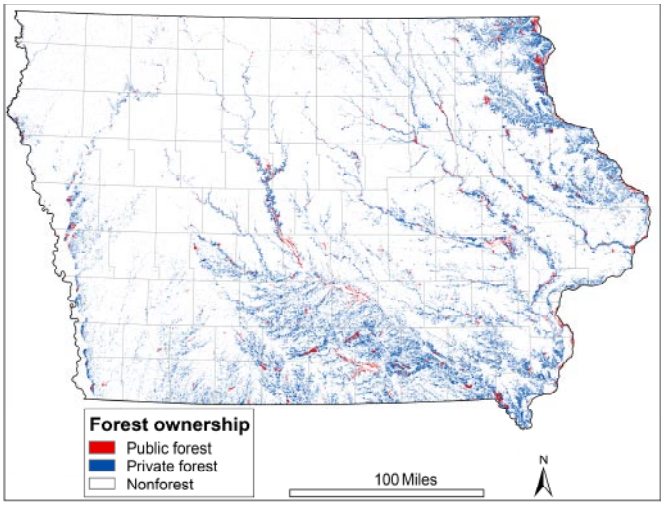


Figure 3.—Distribution of forest land by public (0.469 million acres) and private (2.586 million acres) owner groups, Iowa.

Projection: UTM Zone 15N, NAD83.

Data sources: forest/nonforest - U.S. Forest Service, 2001 Forest Type Groups map, (Ruefenacht et al. 2008); ownership - Conservation Biology Institute, Protected Areas Database, 4.5; basemap - ESRI Data & Maps.

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, and 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 are converting to more shade tolerant species. Iowa has about 10% of its land classified as forest, according to 2008 Forest Inventory Data provided by the Forest Service. That means about 3.1 million acres of Iowa is forested. Most of Iowa's forest land is privately owned, 90% by 150,000 landowners. In 1990 there were 55,000 forest landowners in Iowa that owned on average of 31 acres of forest land. By 2008 the number of forest landowners increased to 150,000 with an average of 17 acres of forested land.

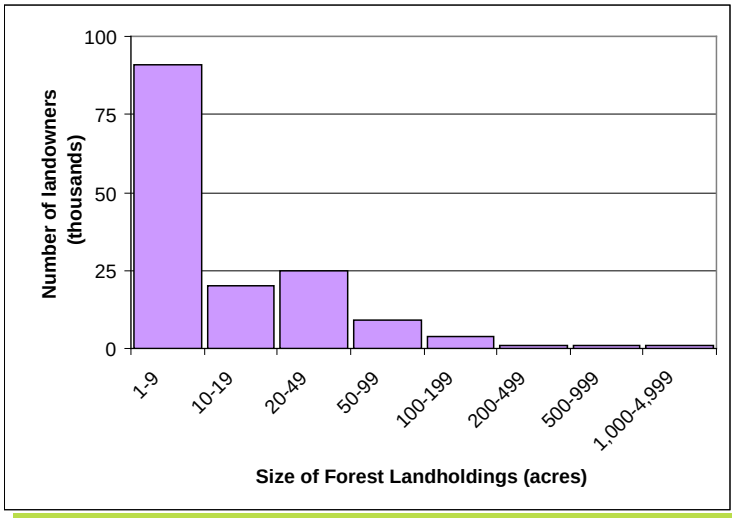
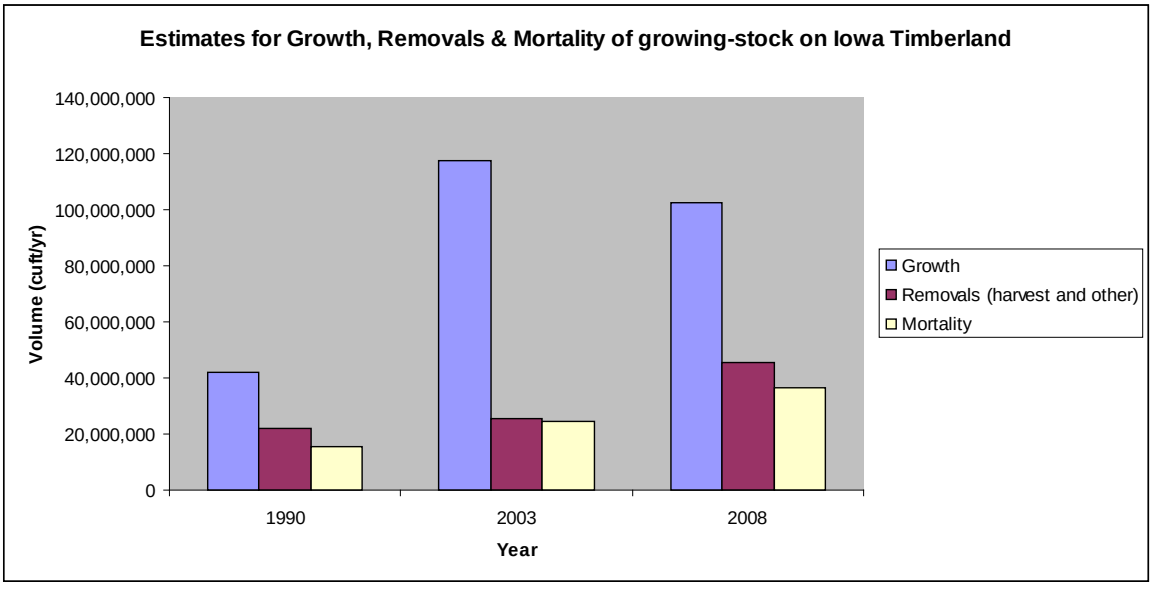


Figure 4.—Number of nonindustrial private forest landowners by size of forest landholding, Iowa, 2006. Data were derived from Butler (2008).

Net annual growth barely exceeded the combined removal and mortality of Iowa's forestland in 2008, the latest FIA data available. The net annual mortality and removals were up from the 2006 FIA. This trend may continue without adequate funding to control forest health issues (mortality). This data is shown in the following bar graph.



Source: Miles, P.D.

Table 1, based on 2008 FIA data, shows 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), and 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?

Table 1.—Top 10 tree species by statewide volume estimates, Iowa, 2008.

Rank	Species	Volume of live trees on forest land (1,000,000 ft^3)	Sampling error (%)	Change since 2006 (%)	Volume of sawtimber trees on timberland (1,000,000 board feet)	Sampling error (%)	Change since 2006 (%)
1	Silver maple	516.2	20.2	4.3	1017.8	20.1	-7.2
2	Bur oak	434.6	11.7	-6.7	1015.1	14.7	-7.9
3	Cottonwood	372.2	31.5	2.0	1549.5	31.4	0.1
4	White oak	351.0	13.5	-0.9	1179.1	15.2	-1.1
5	Black walnut	266.9	12.5	2.5	912.2	15.1	2.4
6	Northern red oak	257.1	15.3	-1.2	965.3	17.7	-1.6
7	American elm	245.2	8.0	3.8	359.5	15.6	7.4
8	American basswood	193.0	15.6	0.3	634.8	18.5	-3.5
9	Hackberry	186.5	13.1	0.9	485.6	16.2	1.7
10	Shagbark hickory	159.2	12.0	-2.7	410.0	15.4	-6.5
	Other softwood species	44.8	16.3	-5.9	79.4	23.8	-24.7
	Other hardwood species	1217.2	4.8	2.5	2369.1	7.5	0.7
	All species	**4243.9**	**4.5**	**0.8**	**10977.6**	**6.1**	**-1.8**

The Value of Iowa's Forests

Over 186 businesses in Iowa utilize the wood grown in Iowa's forests. The forest products industry contributes over $3.9 billion each year to Iowa's economy, including over 18,000 jobs for Iowans (Analysis by E.M. (Ted) Bilek, Economist, USDA Forest Service, Forest Products Laboratory, Madison, WI). Additional detail can be found on page 192 of Iowa's Forests Today.

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

Potential Economic Loss Associated with Emerald Ash Borer on Ash in Iowa

Background

Emerald Ash Borer (*Agrilus planipennis*) is a small green invasive wood boring beetle that attacks and kills ash trees. The adults live on the outside of ash trees feeding on the leaves during the summer months. The larvae look similar to white grubs and feed on the living plant tissue (phloem and cambium) underneath the bark of ash trees. The trees are killed by the tunneling activity of the larvae under the tree's bark, which disrupts the vascular flow.

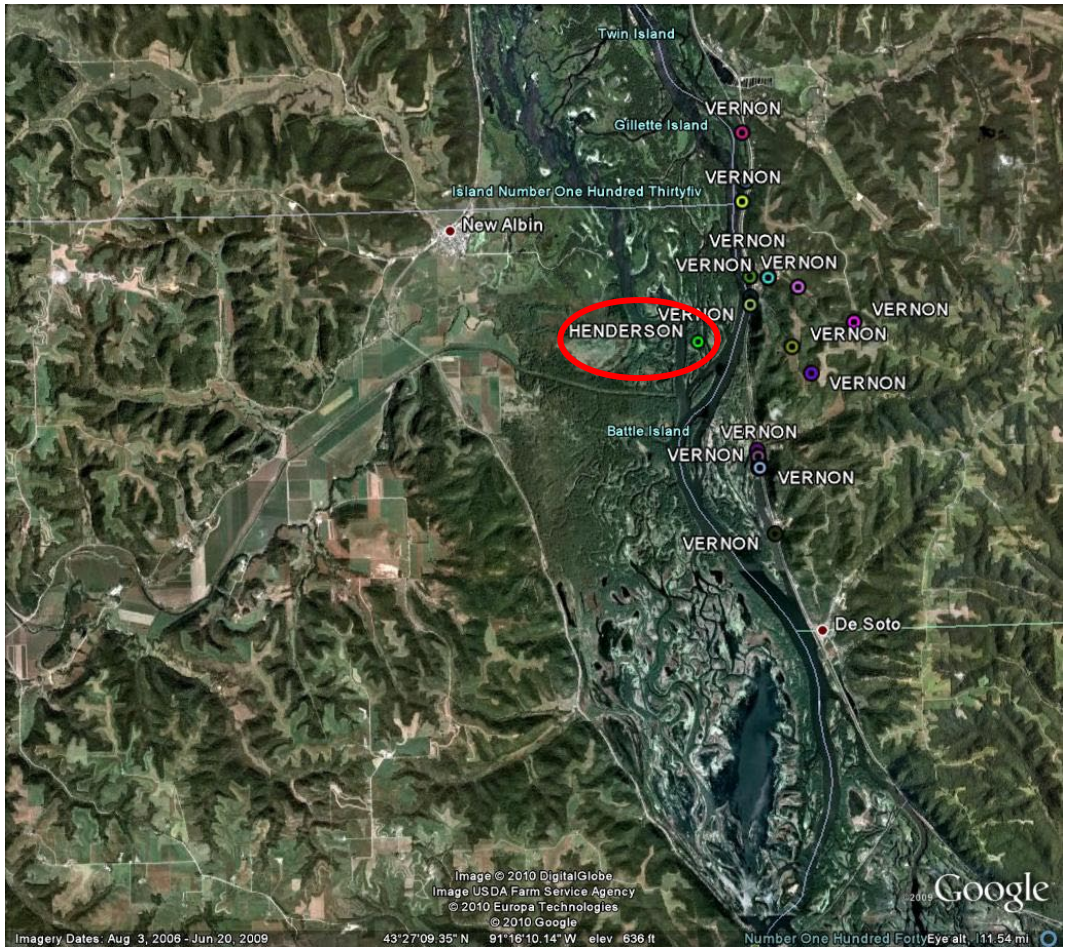
The metallic green beetle is native to East Asia and was imported to the United States within the wood of shipping crates from China. Emerald Ash Borer (EAB) was first discovered in North America near Detroit, Michigan in 2002. Since the first discovery it has also been found in Illinois, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Tennessee, West Virginia, Wisconsin, and Virginia. It has also been found in Ontario and Quebec Canada.

EAB is 100 percent fatal to our native ash trees of any size, age, or stage of health. Millions of ash trees have already been killed in infested areas. Much of Iowa's forestland is populated with ash trees, and Iowa's community street trees are heavily planted with ash cultivars. U.S. Forest Service 2008 inventory indicates that there are 52 million woodland ash trees and 3.1 million urban ash trees. Take a moment to think about how many ash trees are in your yard, neighborhood, community, and woodlands. Then imagine those areas without ash trees. Trees that have been attacked by EAB can die within 2 years.

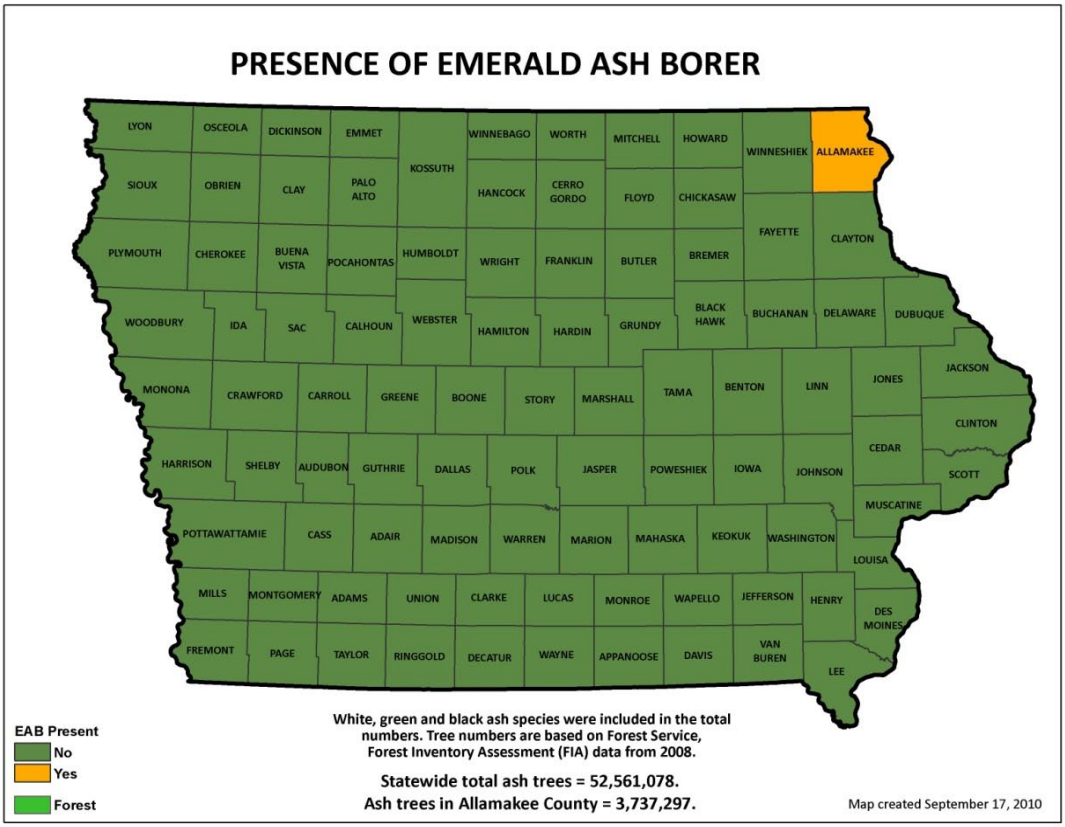
Research has shown that EAB can only fly a few miles, which helps slow its natural spread. However, it is easily transported to new areas when people inadvertently move emerald ash borer larvae inside of infested firewood, ash nursery stock, and other ash items. Please do not move firewood from infested areas into non-infested areas.

During a site visit in May of 2010, four EAB larvae were found in an ash tree growing on an island in the Mississippi River about 2 miles south of the Minnesota border in Allamakee County. This was Iowa's first confirmation of EAB. A quarantine prohibiting the movement of firewood, ash nursery stock, ash timber, or any other article that could further spread EAB is in effect from the Iowa Department of Agriculture and Land Stewardship and USDA-APHIS-PPQ.

The picture below shows one of the Henderson Islands on the Mississippi River where the emerald ash borer positive trees was found in Spring 2010 and where the positive purple trap was placed during the summer 2010 purple trap season.



The map below show the number of ash trees at risk to emerald ash borer in the county that is infested and statewide.

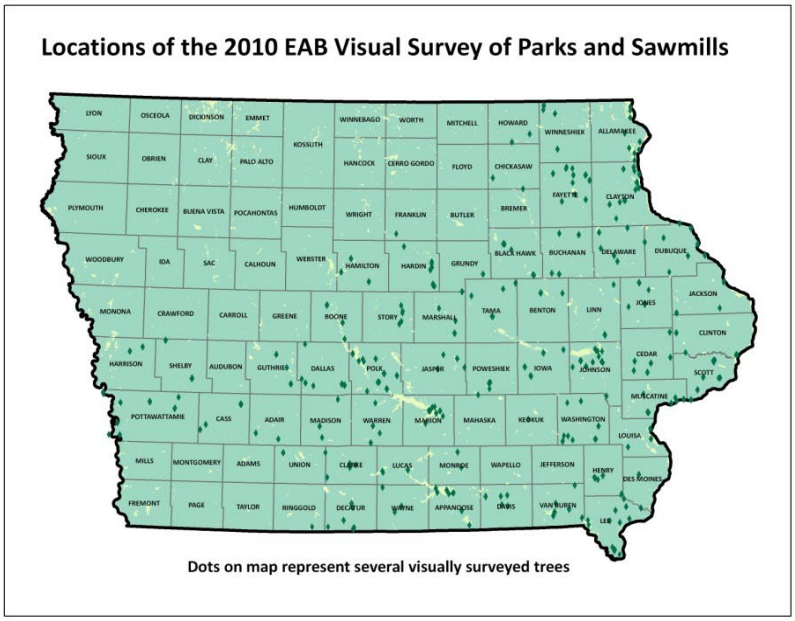


Iowa Emerald Ash Borer Surveillance Effort – 2010

The Iowa Department of Natural Resources (IDNR) Forestry Bureau in cooperation with the 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 Allamakee County in spring 2010 is the first confirmed infestation in Iowa, which is of concern because it is one of Iowa's heavily forested counties and is essential to our timber industry. According to recent sources, Iowa has an estimated 52 million rural ash trees (USFS 2008) and 3.1 million urban ash trees (USFS 2010).

Visual surveys:

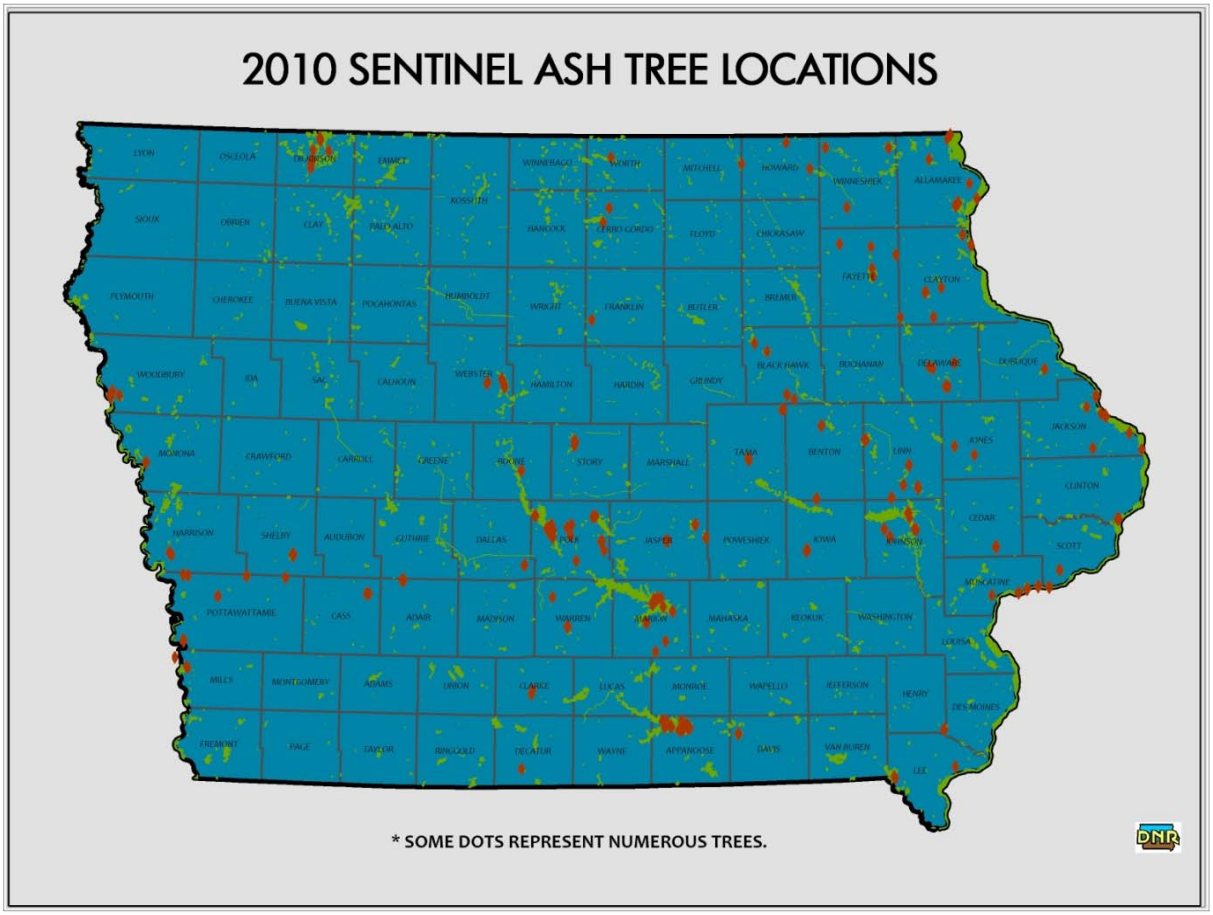
Surveillance efforts have been in place for the past five years in Iowa to look for EAB. For 2004 and 2005, this activity consisted of visual surveys of urban ash trees (towns/cities with a population greater than 1000) in all 99 counties, visual inspection of ash saw logs at 43 sawmills, and ash nursery stock. Visual surveys in 2004 involved 2,078 trees on 252 sites and in 2005 involved 1,318 trees on 238 sites.



During the 2006, 2007, 2008, 2009, and 2010 seasons, 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. In 2009, 234 campgrounds in 55 counties were identified as high risk sites and 1,265 ash trees were inspected. In 2010, the same 234 high risk campgrounds in 55 counties were surveyed. A total of 1,267 were examined and no evidence of EAB was noted during visual surveillance in Iowa (2004 – 2010).

Sentinel trees:
Sentinel trees in Iowa were created by girdling standing ash trees (4-13 inch DBH) and letting the declining trees set for one growing season before bark peeling them to look for emerald ash borer. Sentinel trees were established by December 31, 2009 and bark peeled by December 31, 2010. The trees were girdled by using a folding hand saw or chainsaw, making two cuts through the bark (4 – 6 inches apart), and then removing the bark between the cuts with a drawknife. 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 containers) on 12 sites were also used to monitor for EAB. In 2006, **68** sentinel trees (27 standing, 41 containers) were established on 18 sites; 10 were retained for evaluation in 2007. In 2007, **237** sentinel trees (190 standing, 47 containers) were established on 57 sites. In 2008, **401** sentinel trees (272 standing, 129 containers). In 2009, **423** sentinel trees (294 standing, 129 containers). In 2010, 420 sentinel trees were established. All of these trees are standing trees that are 3-10 inches in diameter.

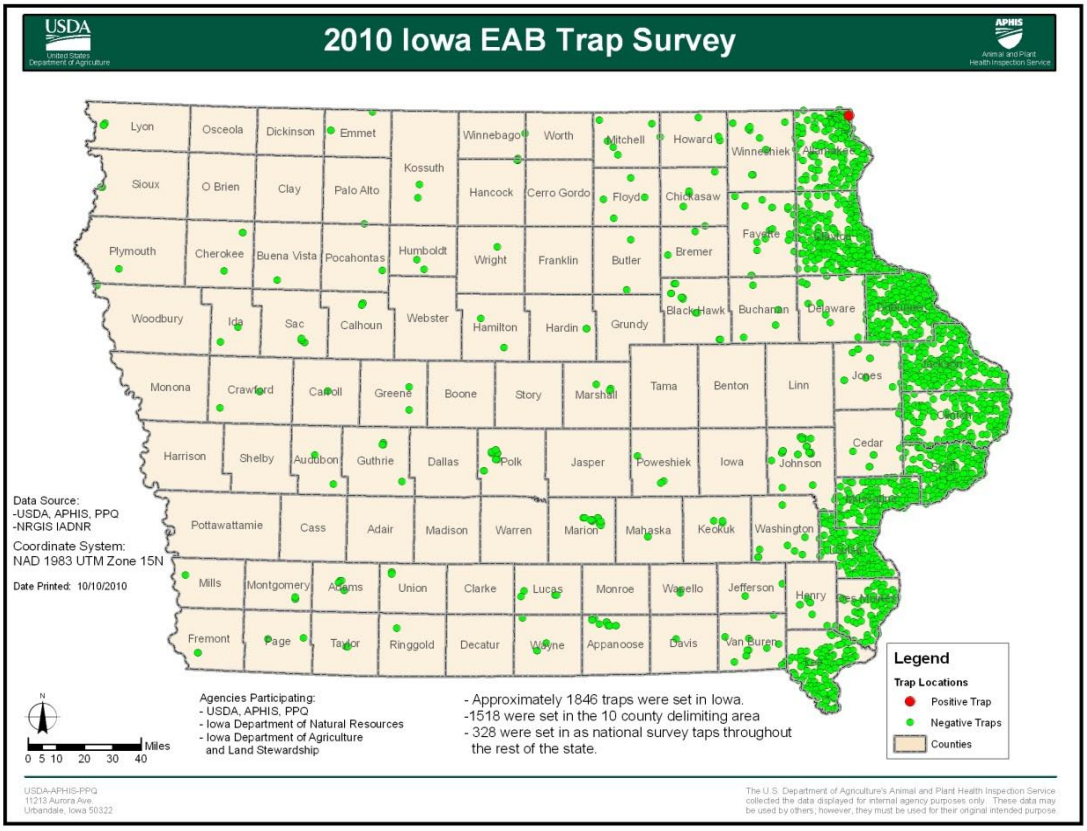


USDA Experimental Traps:

During 2010, 1,846 purple sticky traps were utilized but USDA and DNR for emerald as borer 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 November 2010, suspect insects collected, and traps were discarded.

The picture below is an example of an EAB purple trap in an ash tree. Picture from Mark Shour ISU Extension Entomology.

Thirteen EAB adults were found on one of the 1,846 purple traps during trapping season. The single adult capture was on a purple trap known to be infested on an island in the Mississippi River in Allamakee County.



EAB Control

Long term costs are one of the key issues when deciding whether to remove your ash tree. In most cases, removing the ash tree and replanting it with another species is the most cost effective option. However, there are a few insecticide control options for emerald ash borer that are available on the market.

Treatments, and the cost associated with them, are something to consider when using chemical controls. Many of the insecticides on the market need to be used each year of the tree's life to protect the tree from EAB. These treatments are most effective before EAB infests the ash tree, but it is strongly suggested that chemical controls not be utilized until the pest has been confirmed within 15 miles of where your tree is located. Keep in mind, a chemically treated tree is subject to removal if it is located in an containment area identified by regulatory agencies.

The insecticide options vary from soil drenching, soil injections, trunk sprays, and trunk injections. At this time, soil drench applications are the only option available to the

homeowners. The remaining treatment options tend to be more effective, but would need to be done by an insured reputable tree service.

Soil drenching utilizes a chemical called Imidacloprid that works best for trees that are 8 inches in diameter and under. Imidacloprid can also be applied professionally through soil injections and work well for trees greater than 8 inches in diameter, but would need to be applied once in the spring and again in the fall.

Trunk injections can be done by a professional using Imidacloprid, Bidrin, or Emamectin benzoate. All three options have been successful, but current research suggests that Emamectin benzoate may last up-to 3 years in the tree, making it a more feasible option for long term treatments.

Trunk sprays, such as Dinotefuran with Pentrabark, are not effective over the long term of a tree's life, but can be a useful tool to prevent EAB infestation in a healthy tree located near sites known to have EAB on an annual basis.

Wildlife Impacts

A 2001 National Fish and Wildlife Service survey discovered that 73% of bird watchers visit woodland areas to see some of their favorite birds. In fact, participation in bird watching is 12% higher in Iowa than the national average and ranks 5th among all states in participation rate by state.[1]

Ash has moderate importance to wildlife as a food source. Seeds are known to be eaten by wood ducks, finches, and cardinals. In addition to being a source of food, ash trees are currently a significant part of the forest in Iowa. There are approximately 150,000 wild turkey and 400,000 deer that depend on forests for cover. If ash suffers the same fate from emerald ash borer that elm suffered from Dutch elm disease, there will be a lot less suitable habitat for birds, wild turkey and deer.

Economic Impacts

Based on the latest inventories there are an estimated 52 million ash growing within Iowa's 3 million acres of forest. Based on sawmill surveys, we do know how much ash is harvested for wood products use within Iowa. We can estimate the economic impact of this insect to the wood products industry in Iowa. The next table shows the economic impact harvesting ash has annually at current harvesting rates and prices to forest landowners, loggers and sawmills.

Annual Statewide Wood Products Loss

Annual Volume Harvested (bdft)	2,108,000[2]	sawlogs

[1] Pullis La Rouche, Genevieve. *Birding in the United States: A Demographic and Economic Analysis*. Publication. Washington, D.C.: U.S. Fish and Wildlife Service, 2003. Print.

[2] Haugen, David E.; Michel, Dennis D. 2010. Iowa timber industry-an assessment of timber product output and use, 2005. Resource Bulletin NRS-38. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 62 p.

Estimated Economic value to Landowners	$421,600	Assuming $0.2/ bdft profit
Estimated Economic value to Loggers	$421,600	Assuming $0.2/ bdft profit
Estimated Economic value to Mills	$421,600	Assuming $0.2/ bdft profit
Total Direct Economic Impact	$1,264,800	
Indirect Economic Impact	$632,400	Assuming 50% based on IMPLAN
Total Economic Impact	**$1,897,200**	

Based on 2008 estimates, Iowa had over 336 million board feet of merchantable size ash growing on all forest land. The potential loss of income of this readily available resource to Iowa forest landowners is summarized in the table below. This is the estimated timber value of the ash resource that exists today in Iowa's forests.

Statewide Landowner Value

Volume Available to be Harvested (bdft)	336,871,000[3]	sawlogs
Estimated Economic value to Landowners	$67,374,351	Assuming $0.2/ bdft profit
Estimated Economic value to Loggers	$67,374,351	Assuming $0.2/ bdft profit
Estimated Economic value to Mills	$67,374,351	Assuming $0.2/ bdft profit
Total Direct Economic Impact	$202,123,052	
Indirect Economic Impact	$101,061,526	Assuming 50% based on IMPLAN
Total Economic Impact	**$303,184,578**	

Tree canopy for Iowa communities averages 12%.[4] Losses from affected urban trees include the cost of removing the tree, its "landscape value" and the cost of replacing that tree. Landscape value is a catch-all term that includes everything from a tree's aesthetic value to its impact on property values, pollution removed from the environment and utility costs. Losses from affected urban trees are not annual, but rather a one-time phenomena, although spread out over many years. These numbers assume residential trees on private property represent the same percentages for ash as is being documented during street tree inventories. Community street tree inventories do not take into account ash occurring in city parks and other urban areas or on private

[3] Miles, P.D. Forest Inventory EVALIDator web-application version 4.01 beta. St.Paul, MN:U.S. Department of Agriculture, Forest Service, Northern Research Station. September 27, 2010 http://fiatools.fs.fed.us/Evalidator 4/tmattribute.jsp

[4] Nowak, David J.; Greenfield, Eric J. 2010. Urban and community forests of the North Central West region: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota. Gen. Tech. Rep. NRS-56. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 70 p.

residential areas. Communities and homeowners will bear the cost burden of removing dead trees caused by emerald ash borer.

Statewide Urban Tree Loss

Number of Ash Trees[5]	3,120,000	Based on 26 million urban trees[6]
Removal Costs[7]	$1,560,000,000	$500/ tree
Landscape Value[8]	$ 536,640,000	$172/ tree annually
Replacement Cost[9]	$5,216,640,000	$1,672/ tree at the current size
Total Economic Impact	**$7,313,280,000**	

To determine the total economic impact to the wood products industry, annual industry losses are calculated in the table below using existing harvesting rates. Little is known about the how fast bur oak blight will cause its host to die. There are not any known viable treatments to help trees in forested areas at this time. Assuming this disease takes 20 years to infect every bur oak tree in Iowa, we can estimate losses by determining the net present value (NPV) of each year's impact. NPV translates future dollars into today's dollars, using a discount rate. One way of thinking about NPV is to imagine paying for future losses by putting some money in the bank today. For example, putting $100 in the bank today at a 5% interest rate could pay for $105 in damages next year.

Net Present Value Calculation of Loss of Bur Oak over the next 20 years in Woodlands; assuming 5% discount rate and indirect impact rate of 50%.

Year	**Wood Products Industry** (Future Dollars)	**Present Value** (2010 Dollars)
2010	$ 595,820	$ 595,820
2011	$ 1,191,639	$ 1,134,895
2012	$ 1,787,459	$ 1,621,278
…..	**…..**	**…..**
2028	$ 11,320,574	$ 4,703,932
2029	$ 11,916,393	$ 4, 715,721
Total (during spread)		$ 69,411,892
Years 2030 on (Total)	$ 11,916,393	$ 89,823,266
Total Present Value of the loss		**$ 25,351,710**
Discount Rate		5%
Total Annualized Value of the Loss		**$ 1,267,585**

[5] Iowa community Forestry Tree Inventories, 23 communities, average number of street trees.
[6] Nowak, David J.
[7] Average removal and stump grinding costs, communication with Iowa arboriculture industry.
[8] Estimated using i-Tree STRATUM Analysis
[9] Estimated using i-Tree STRATUM Analysis

Conclusion

Under these assumptions, the total impact of Emerald Ash Borer to Iowa's wood products businesses is over **$25 million** or an annualized loss of close to **$1.3 million** in 2010 dollars for now into perpetuity for Iowa's economy. The result changes with the discount rate (for example, the total present value of losses go up if the discount rate goes down to the current Federal Funds rate target of 0.25%). Additionally, other economic losses would include non-timber products like seed production, reduced wildlife habitat and a **$7.3 billion** loss of services from community trees. If Iowa can slow the spread, or find a solution to stop the spread of Emerald Ash Borer – losses to homeowners, wildlife, forest landowners and the wood products industry can be mitigated.

If you have potential ash tree infested with Emerald Ash Borer, please contact Tivon Feeley at tivon.feeley@dnr.iowa.gov or 515-281-4915 for answers to your questions.

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Pullis La Rouche, Genevieve. *Birding in the United States: A Demographic and Economic Analysis*. Publication. 1st ed. Vol. 2001. Washington, D.C.: U.S. Fish and Wildlife Service, 2003. Print.

Additional EAB Outreach:
Educational efforts in Iowa during 2010 included C 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.
- 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 information was distributed at the Iowa State Fair.
- 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, and links to the national EAB Web site. The URL for this site is: http://www.extension.iastate.edu/pme/home/pests/EAB.php
- Billboards 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.
- Blaze Orange signs asking campers to “Declare out of State Firewood” was placed in high risk DNR campgrounds.
- IDNR sent out regular press releases informing Iowa citizens about the EAB and the trapping methods being used.
- IDNR created the comprehensive EAB Toolkit to provide information to Iowa citizens and municipalities to help prepare the EAB arrival. http://www.iowadnr.gov/forestry/eab/index.html

A map showing the current known locations of EAB in the United States can be viewed in Map 1 in Appendix A. Also in Appendix A, 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 .

Potential Economic Loss Associated with Gypsy Moth on Trees in Iowa

Background

Gypsy Moth is a European insect species introduced in Boston, MA in 1869 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 it becomes established and has become the most important defoliating insect of hardwood trees in the Eastern U.S.

Establishment of gypsy moth in Iowa will affect the survival of both the mature and oldest trees the most. The larvae of this insect will feed on the leaves of over 300 host species during the summer removing a trees 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.

The 2010 gypsy moth survey conducted by Iowa Department of Natural Resources (IDNR) foresters, Iowa Department of Agriculture and Land Stewardship (IDALS), and U.S.D.A Animal Plant and Health Inspection Service (APHIS) have found a record number of male gypsy moths present in Iowa. The survey, which has been occurring in Iowa since 1972, collected a record 2,260 male gypsy moths in 2010.

The concern of having gypsy moth moving into Iowa, is the potential loss of economically critical and ecologically dominant oak species (Quercus, spp.). The oak-hickory forest type is 26% of Iowa's total tree cover. And about 27 million trees (15%) of that forest are over 80 years old.[10] Most studies of forest compositional changes associated with gypsy moth defoliation indicate that less susceptible species will replace oak trees.

Upon first arrival, extensive mortality of trees usually occurs after two consecutive years of defoliation. However, mortality can occur after one year of defoliation if other environmental stressors, like drought or tatters are present. Heavy defoliation increases the stress on those trees, which can make them more susceptible to other insect (two-lined chestnut borer) and disease (shoestring root rot) problems.

[10] Miles, P.D. Forest Inventory EVALIDator web-application version4.01 beta. St.Paul, MN:U.S. Department of Agriculture, Forest Service, Northern Research Station. September 27, 2010 http://fiatools.fs.fed.us/Evalidator4/tmattribute.jsp

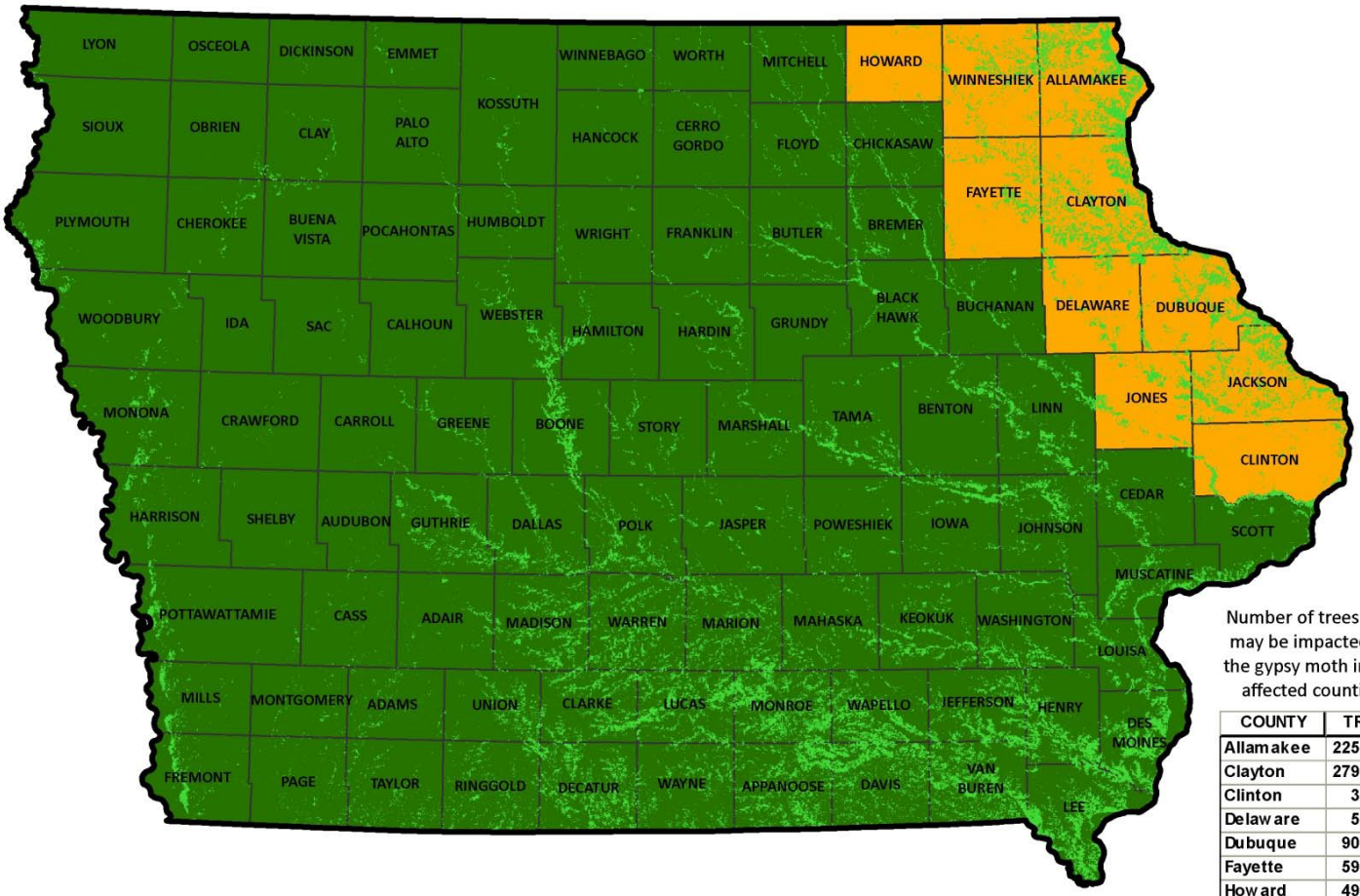
Losing leaves early during the growing season, reduces the amount of growth those trees will be able to produce for that year, which results in lost income or delayed income to forest landowners, if timber is a product they are managing. If the trees are oaks, they will abort their acorns, resulting in less food for wildlife that eat acorns in the fall, along with less oak regeneration getting established. Forest ecosystems suffer from the loss of shade that the leaves would have offered as protection for birds and their offspring. More light reaches the forest floor which can help invasive plants grow and spread faster. Many native understory plants grow better under shady conditions.

Defoliation reduces the beauty that forests provide along scenic byways, state forests, state parks, and county parks in the area, which will diminish recreational experiences for both residents and visitors. Reduced camping within infested areas will reduce revenue for those parks along with increasing costs due to clean-up after the mess this insect makes.

When populations of gypsy moth caterpillars build up in trees and on houses, the noise they create from chewing leaves becomes noticeable and the continual dropping of fecal material onto patios, sidewalks, cars and people is not pleasant. This fecal material increases uric acid, nitrates and coliform bacteria in lakes and streams where it gets washed into. Another effect caused by gypsy moth feeding is reduced property values and increased utility bills as trees are lost, usually the older more established majestic trees. Finally, some people are allergic to the hairs on gypsy moth egg masses, larvae and adult moths.

Based on survey for male gypsy moths in 2010, 31 counties in Iowa reported the presence of the insect. Within these counties there are over 80 million host tree species that are suitable for this insect to feed on. The map on the following page shows the distribution of gypsy moth in relation to the existing forest resource.

CURRENT COUNTIES IMPACTED BY GYPSY MOTH



Number of trees that may be impacted by the gypsy moth in the affected counties.

COUNTY	TREES
Allamakee	22584478
Clayton	27933557
Clinton	309094
Delaware	576205
Dubuque	9095299
Fayette	5968063
Howard	4990155
Jackson	6785664
Jones	144981
Winneshiek	2345665
TOTAL	80733161

Forest

Gypsy Moth Impact

No

Yes

Species included in the numbers are hawthorn, American basswood, oaks, willows, red cedars, plum and pines. The numbers are based on Forest Service, Forest Inventory Assessment (FIA) data, 2008.

Statewide total trees which could be impacted by gypsy moth = 225,514,182.

Total number of host-tree species in impacted counties = 80,733,161

Map created September 17, 2010

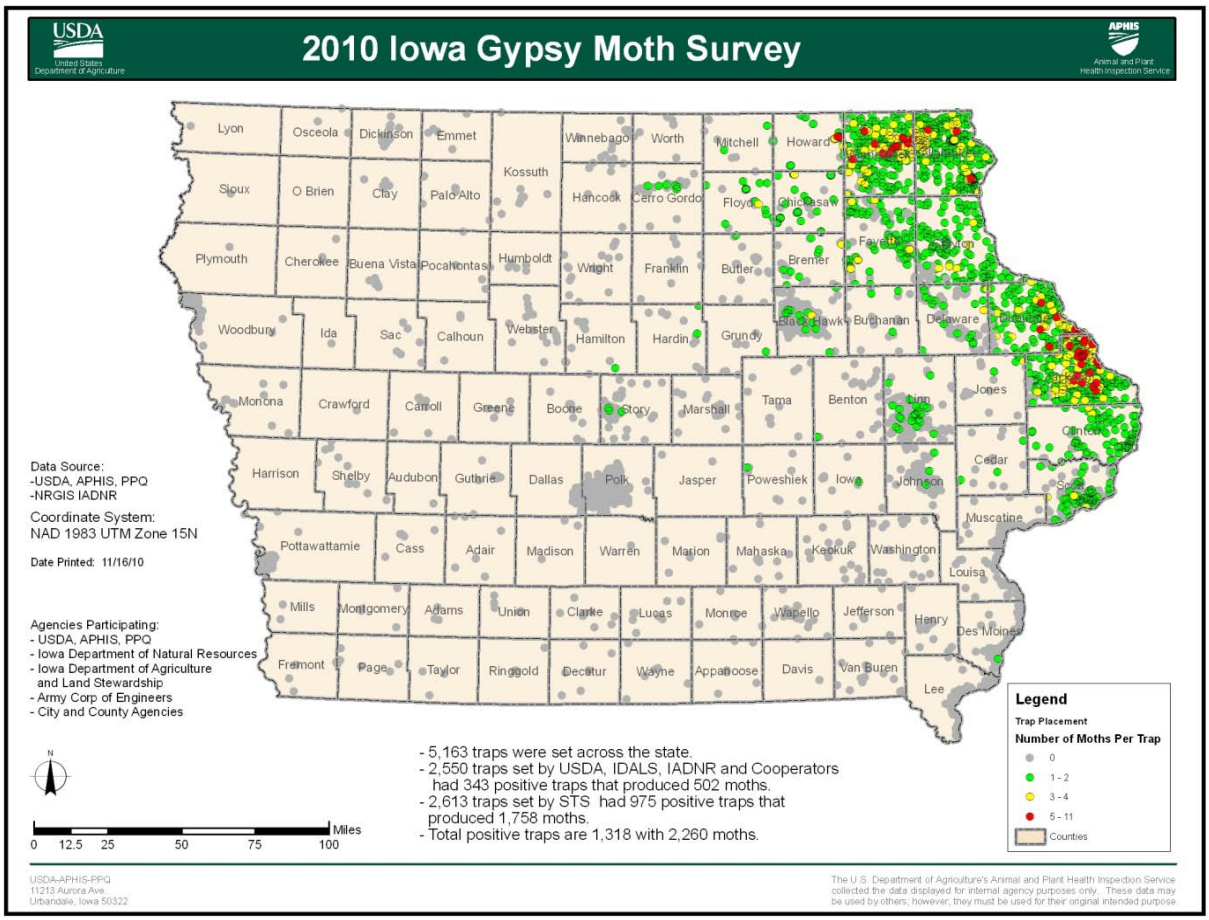
Current Gypsy Moth Trap Information

The gypsy moth trap locations in 2010 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 2010 the following agencies were involved with gypsy moth trapping:

Agency	Employees	Traps
IDALS	4	213
PPQ	4	1651
Contractors	2	819
IA DNR	9	2,480
Total	19 Employees	5163 traps

DNR hired two contractors that were paid by the number of traps they set-up ($10/ trap) and took down ($10/ trap). If 95% of the traps were placed in the correct locations the contractor was rewarded an additional $5/ 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.



This will be the third year that Iowa will be working with the USDA Slow the Spread Foundation to set traps in Allamakee, Winneshiek, Fayette, Clayton, Delaware, Dubuque, Jackson, and Clinton Counties. Using the STS calculations, a projected 3,500 traps will be setup in those counties alone while maintain approximately 4,000 traps outside the STS zone. Within the STS zone in Iowa, 21 areas were identified to start delimit trapping and about 90,000 acres to start mating disruption utilizing pheromone flakes It is likely that another 5 counties will be part of the STS zone in 2011 to help detect and monitor potential infestations.

Control

The decision to treat and control the gypsy moth populations is influenced by a number of factors including: the total number of male moths captured in traps, the number of visible gypsy moth egg masses, whether the area is adjacent to a heavily infested area, and whether the trees are defoliated or have dead and dying branches near the top of the tree were the caterpillars feed.

There are several insecticides that can be used as part of a suppression spray program The safest are pheromone flakes, such as Disrupt II™ and SPLAT™, that disrupt the natural mating pattern by prevent the male moths from finding the female moths to breed. Matting disruption flakes "flood" the area with the scent of natural pheromone that the female moths produce, preventing the males from finding the female. Mating disruption can be effective at a low to medium level of infestation. The cost of mating disruption is $8.00 per acre (6 grams used for low level outbreaks) or $14 per acres (15 grams used for moderate to heavy outbreaks).

Gypcheck™ is another commonly used viral insecticide that contains a virus that is specific to the gypsy moth caterpillars and can cause the populations to crash. Gypcheck™ is typically used in low level outbreaks and can be used in conjunction with any other treatment option. Gypcheck™ cost about $25 per acre treated.

A formulation of the bacterial insecticide *Bacillus thuringiensis kurstakii* (Btk) is only used when the gypsy moth populations are at a moderate to high level. Btk is the least toxic pesticide (after pheromone flakes and the viral insecticides), but it is not specific to gypsy moths and may cause other native caterpillar populations to crash. That is why Btk is used only when gypsy moths are at outbreak levels, and this insecticide can be used in limited areas to control gypsy moth population. When *Btk* is taken internally, the insect becomes paralyzed, stops feeding, and dies of starvation or disease. The cost of Btk is about $22 per acre.

The control treatment options are all applied aerially to ensure that the pesticide lands on the tree canopy where it is effective. Ground-spraying is prohibitively expensive on a large area and are generally ineffective when the gypsy moth populations are on more than just a few trees.

The planes apply the control measures in late May and early June and fly roughly 50 feet above the canopy of the trees to ensure that the control method adheres to the

foliage were it is effective. It takes about 30 minutes for the planes to treat a minimum of 600 acres.

The Gypsy Moth Slow the Spread Foundation, Inc. is a nonprofit organization that was established for the purpose of aiding in the implementation of the USDA National Slow the Spread Gypsy Moth Project, which is part of the USDA's national strategy for gypsy moth management. By unifying partners and coordinating efforts among agencies, a well-coordinated action plan based on biological need using target treatment options has slowed the spread of gypsy moth to an average rate of 3 miles per year. The benefit to cost ratio is more than 4:1, when looking at the impacts gypsy moth has on new areas.

Iowa has been part of the Slow the Spread Foundation since 2007. The foundation has provided funding to help place pheromone traps to capture male gypsy moths in the area. This trap data is used at a national level to determine the rate of spread of gypsy moth and to identify areas where control measures will need to be implemented. Due to the high moth capture in Iowa during the 2010 season, it is extremely likely that the foundation will financially assist Iowa in starting a mating disruption program. The foundation continues to assist states with trapping control implementation until the moth has fully established itself in part or all of the state. Once that happens, the cost of trapping and control is left to the State of Iowa.

Wildlife Impacts

As oak trees die from gypsy moth defoliation there will be less of this kind of habitat for the 200-300 wildlife species that depend on these trees for habitat and food, thus reducing opportunities to view or hunt for that wildlife in the future.

Acorns produced by oaks are eaten by many species of birds and mammals including deer, squirrels, mice, rabbits, foxes, raccoons, grackles, turkey, grouse, quail, blue jays, woodpeckers, and water-fowl.[11] The populations and health of wildlife often rise and fall with the availability of acorns in a forest. A reduction in the number of oak trees in Iowa's forests caused by bur oak blight and gypsy moth defoliation will affect a wide variety of game and non-game species of wildlife.

Primary Winter Food for Deer (Order of Importance)
1.) Acorns
2.) Corn
3.) Coralberry
4.) Sumac
5.) Grass & Sedges

A primary fall and winter food for deer is acorns, composing around 54% of a deer's yearly diet. It has been estimated that in order to fulfill the needs of forest wildlife, 20 mast producing trees are necessary per acre. The number of trees per acre to produce an adequate supply of acorns for forest wildlife will depend on the population of forest wildlife, weather, the size, age and health of those mast producing trees.[12] During years when not enough mast is produced by oak trees, more consumption of corn and other vegetation in the area is utilized.

[11] <www.fnr.purdue.edu/inwood/past%20issues/HowtoManageOakForestsforAcornProduction.htm>. Sept. 27 2010.
[12] <http://mdc.mo.gov/landwater-care/animal-management/deer-management/planning-ahead-wildlife-survival-white-tailed-deer->. Sept 27 2010.

In addition to being a source of food, oaks are currently a significant part of the largest forest type in Iowa. There are approximately 150,000 wild turkey and 400,000 deer that depend on forests for cover and search out oaks for mast before winter. Trees growing along river corridors, provide shade that decreases water temperatures in the water below; sustaining fish populations that wouldn't otherwise exist. For example, native trout streams need a water temperature below 75 degrees for the trout to survive. A reduction in the oak-hickory forest type will negatively impact the economic contribution of $1.5 billion that fish and wildlife recreation provides to Iowa's economy.

The picture above is an example of what will happen to forested areas across Iowa, as gypsy moth population's increase. Notice the brown areas that would have been green in this picture, if gypsy moths hadn't eaten the leaves off of the trees in June.

Economic Impacts

Since there are so many tree species that gypsy most can feed on and defoliate, for analysis purposes only the tree species ranked with the highest suitability rating were grouped together. Bur oak was omitted because the economic impact has been calculated for it in regards to bur oak blight. We can estimate the economic impact of gypsy moth to the wood products industry in Iowa based on current harvesting rates for trees with the highest suitability rating to be impacted by gypsy moth.[13] The next table shows the economic impact harvesting the most suitable host trees for gypsy moth has annually at current harvesting rates and prices to forest landowners, loggers and sawmills.

Annual Statewide Wood Products Loss

Annual Volume Harvested (bdft)	42,642,000[14]	Sawlogs (subtracted bur oak)
Estimated Economic value to Landowners	$ 8,528,517	Assuming $0.2/ bdft profit
Estimated Economic value to Loggers	$ 8,528,517	Assuming $0.2/ bdft profit
Estimated Economic value to Mills	$ 8,528,517	Assuming $0.2/ bdft profit
Total Direct Economic Impact	$ 25,585,550	
Indirect Economic Impact	$ 12,792,775	Assuming 50% based on IMPLAN
Total Economic Impact	**$ 38,378,325**	

Based on 2008 estimates, Iowa had 4.8 billion board feet of merchantable size trees that are the most preferred by gypsy moth for food within Iowa's 3 million acres of forest. The potential loss of income of this readily available resource to Iowa forest landowners is summarized in the table on the following page. This is the estimated timber value of the bur oak resource that exists today in Iowa's forests.

Statewide Landowner Value

Total Merchantable Volume (bdft)	3,712,680,562[15]	Sawlogs
Estimated Economic value to Landowners	$ 742,536,112	Assuming $0.2/ bdft profit
Estimated Economic value to Loggers	$ 742,536,112	Assuming $0.2/ bdft profit
Estimated Economic value to Mills	$ 742,536,112	Assuming $0.2/ bdft profit
Total Direct Economic Impact	$ 2,227,608,337	

[13] <www.fs.fed.us/ne/morgantown/4557/gmoth/gtr/tab2.html> October 4, 2010.

[14] Miles, P.D. Forest Inventory EVALIDator web-application version4.01 beta. St.Paul, MN:U.S. Department of Agriculture, Forest Service, Northern Research Station. September 27, 2010 http://fiatools.fs.fed.us/Evalidator4/tmattribute.jsp

[15] Miles, P.D. Forest Inventory EVALIDator web-application version 4.01 beta. St.Paul, MN:U.S. Department of Agriculture, Forest Service, Northern Research Station. September 27, 2010 http://fiatools.fs.fed.us/Evalidator 4/tmattribute.jsp

Indirect Economic Impact	$ 1,113,804,168	Assuming 50% based on IMPLAN
Total Economic Impact	**$ 3,341,412,506**	

Gypsy moth defoliates not only woodland trees but valuable park and ornamental trees. In urban situations, gypsy moth caterpillars are a significant nuisance during May, June, July as they crawl over homes, vehicles, outdoor furniture, and lawns leaving waste from their feeding. With tree canopy in Iowa communities averaging 12%, keeping urban trees healthy is important. Losses from affected urban trees include the cost of removing the tree, its "landscape value" and the cost of replacing that tree. Landscape value is a catch-all term that includes everything from a tree's aesthetic value to its impact on property values, pollution removed from the environment and utility costs. Losses from affected urban trees are not annual, but rather a one-time phenomena, although spread out over many years. These numbers assume residential trees on private property represent the same percentages for preferred gypsy moth host trees as is being documented during street tree inventories. Community street tree inventories do not take into account these trees occurring in city parks and other urban areas or on private residential areas. Communities and homeowners will bear the cost burden of removing dead trees caused by gypsy moth defoliation.

Statewide Urban Tree Loss

Number of Trees[16]	5,500,000	Based on 26 million street trees
Removal Costs[17]	$ 2,750,000,000	$500/ tree
Landscape Value[18]	$ 550,000,000	$100/ tree annually
Replacement Cost[19]	$ 9,421,500,000	$1,713/ tree at the current size
Total Economic Impact	**$ 12,721,500,000**	

To determine the total economic impact to the wood products industry, annual industry losses are calculated in the table below using existing harvesting rates for tree species preferred by gypsy moth. Assuming gypsy moth takes 20 years to infect every preferred tree species in Iowa, we can estimate losses by determining the net present value (NPV) of each year's impact. NPV translates future dollars into today's dollars, using a discount rate. One way of thinking about NPV is to imagine paying for future losses by putting some money in the bank today. For example, putting $100 in the bank today at a 5% interest rate could pay for $105 in damages next year.

[16] Iowa community Forestry Tree Inventories, 23 communities, average number of street trees.
[17] Average removal and stump grinding costs, communication with Iowa arboriculture industry.
[18] Estimated using i-Tree STRATUM Analysis
[19] Estimated using i-Tree STRATUM Analysis

Net Present Value Calculation of preferred tree species as a result of gypsy moth defoliation over the next 20 years in Woodlands; assuming 5% discount rate and indirect impact rate of 50%.

Year	**Wood Products Industry** (Future Dollars)	**Present Value** (2010 Dollars)
2010	$1,918,916	$ 1,918,916
2011	$ 3,837,833	$ 3,655,079
2012	$ 5,756,749	$ 5,221,541
…..	…..	…..
2028	$ 36,459,409	$ 15,149,638
2029	$ 38,378,326	$ 15,187,607
Total (during spread)		$ 223,550,207
Years 2030 on (Total)	$ 38,378,326	$ 289,287,746
Total Present Value of the loss		**$ 512,837,952**
Discount Rate		5%
Total Annualized Value of the Loss		**$ 25,641,898**

Conclusion

Under these assumptions, the total impact of Gypsy Moth to Iowa's wood products businesses is over **$512 million** or an annualized loss of over **$25 million** in 2010 dollars for now into perpetuity for Iowa's economy. The result changes with the discount rate (for example, the total present value of losses go up if the discount rate goes down to the current Federal Funds rate target of 0.25%). Additionally, other economic losses would include non-timber products like nut production, reduced wildlife habitat and a **$12.7 billion** loss of services from community trees. Job losses associated with this economic impact were not calculated because of access restrictions to that data. If Iowa can slow the spread, or find a solution to stop the spread of Gypsy Moth– losses to homeowners, wildlife, forest landowners and the wood products industry can be mitigated. .

If you have potential Gypsy Moth egg masses, please contact Tivon Feeley at tivon.feeley@dnr.iowa.gov or 515-281-4915 for instructions or questions. A photograph may help diagnosis.

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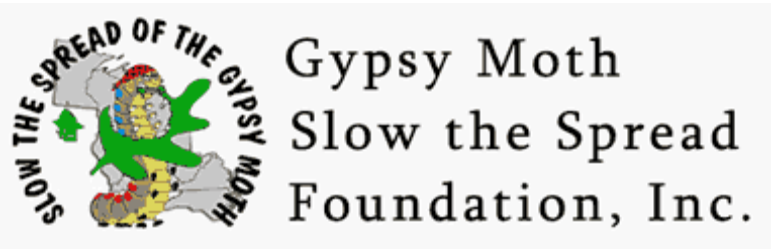


The Threat :

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.
- 75 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 6 years, this program has prevented the impacts that would have occurred on more than 40 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 150 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 more than 4 to 1 by delaying the onset of impacts that occur as gypsy moth invades new areas.

Potential Economic Loss Associated with Bur Oak Blight Disease on Bur Oak in Iowa

Background

Bur oak (*Quercus macrocarpa*) is common across Iowa. In 2008, bur oak ranked second among all tree species as measured in volume of sawtimber on forest land. Bur oak provides substantial value for wood products and is an important source of wildlife habitat and mast (acorns) to many game and non-game species.

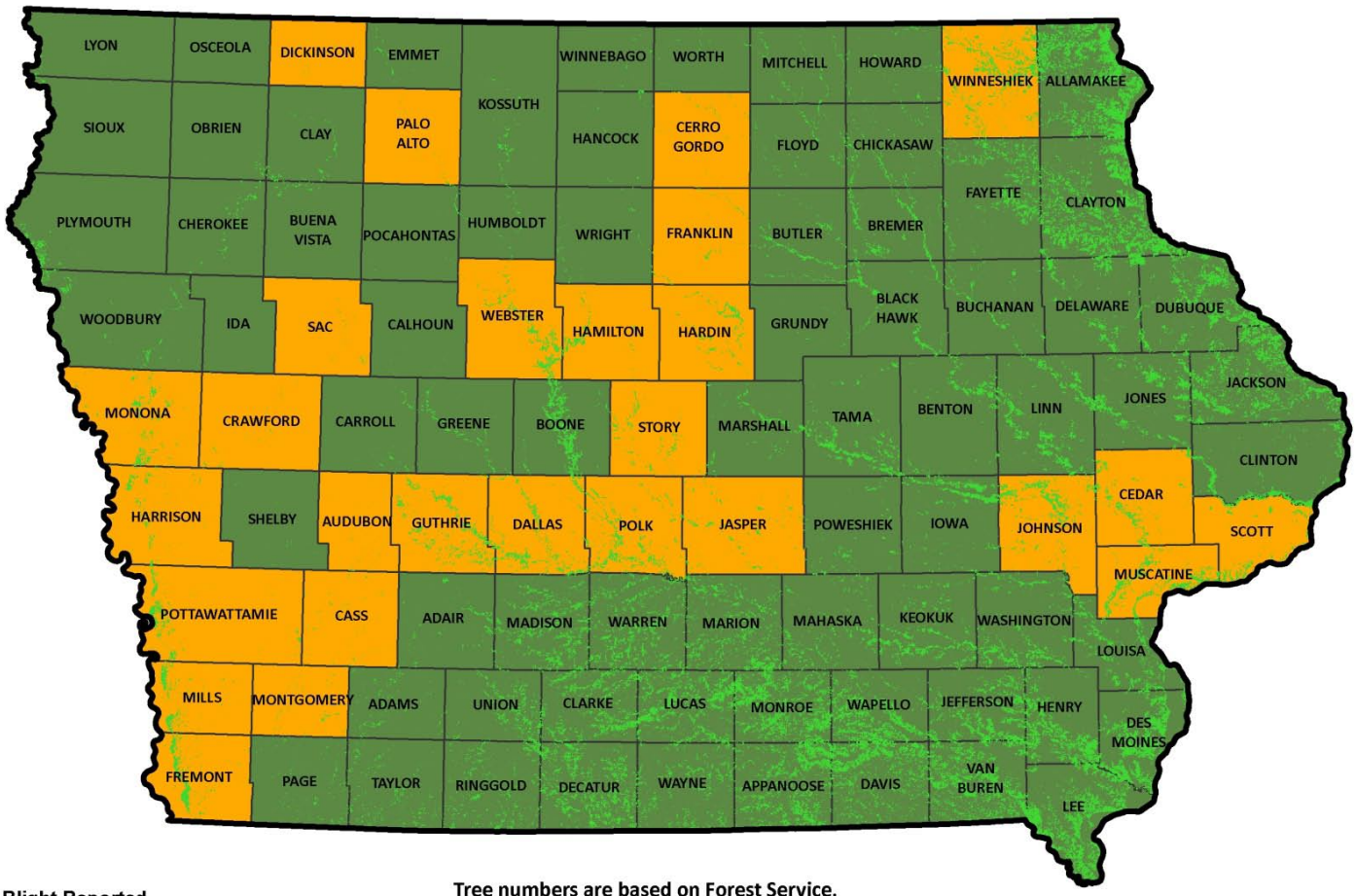
Recent observations by Iowa Department of Natural Resources (IDNR) foresters and investigations by Iowa State University (ISU) have identified a serious threat to bur oak. Bur oak blight (BOB; *Tubakia spp.*) is a newly named disease that shows symptoms of v-shaped brown discoloration of leaves and browning of veins (see picture to the right). Unlike other European and Asian *Tubakia spp.* that are endophytes, causing minor leaf spotting, BOB can cause severe defoliation that can lead to mortality of branches or entire trees.

Bur oak blight is caused by an undescribed species of Tubakia. Thus far, the disease is known from eastern Nebraska to southern Minnesota and southwestern Wisconsin, and it appears to be spread across all of Iowa. It is not clear if the fungus is new to this region or if a shift in climate (more early-season rain events) have made this disease more noticeable over the last two decades.

Bur oak trees infected with BOB tend to retain the infected leaves overwinter and not drop the leaves in the fall like a healthy bur oak would do. These infected leaves overwinter on the tree and act as a source of inoculums for the healthy leaves that emerge in the spring and grow against the infected leaves from the previous year. The succulent emerging leaves become infected with BOB and the symptoms progress slowly until the leaves start browning in late summer.

Based on reports of bur oak blight to the Iowa State Plant Insect and Disease Clinic in 2010, 27 counties in Iowa reported the presence of the disease. Within these counties there are over 8.7 million (27%) bur oaks out of Iowa's over 32 million bur oak trees growing. The map on the following page shows the distribution of bur oak blight in relation to the existing forest resource. ISU and the IDNR are working with their U.S. Forest Service counterparts to keep a watchful eye on Iowa's valuable bur oak resource.

REPORTED DISTRIBUTION OF BUR OAK BLIGHT



Bur Oak Blight Reported

- No
- Yes
- Forest

Tree numbers are based on Forest Service, Forest Inventory Assessment (FIA) data from 2008.

Statewide total bur oak trees = 32,266,154.

Bur oak trees within counties reporting the disease = 8,700,000.

Map created September 17, 2010

Control

Recent trials using macro injections of the fungicide called Alamo™ appear to have assisted the trees recovery from bur oak blight. The Alamo™ injections did have some phototoxic effects to bur oak trees requiring very careful measurements of the pesticide. In each injected tree, a Certified Arborist familiar with the fungicide did the work to limit the leaf burning as a result of the phototoxicity of the fungicide.

The trees appeared to by symptomless for the first two seasons after being injected. However, it is very likely that subsequent injections would be required when bur oak blight starts to defoliate the tree again. As always, it is important to have bur oak blight diagnosed by the ISU identifiers before injecting the trees again. This control has an average cost of $15 per inch of diameter of the tree trunk. Given the treatment method, and cost associated with it, the injection would only be suggested for high value street or yard bur oak trees. No feasible treatments have been identified for control in forest settings.

Wildlife Impacts

A 2001 National Fish and Wildlife Service survey discovered that 73% of bird watchers visit woodland areas to see some of their favorite birds. In fact, participation in bird watching is 12% higher in Iowa than the national average and ranks 5th among all states in participation rate by state.[20]

Acorns produced by bur oaks are eaten by many species of birds and mammals including deer, squirrels, mice, rabbits, foxes, raccoons, grackles, turkey, grouse, quail, blue jays, woodpeckers, and water-fowl.[21] The populations and health of wildlife often rise and fall with the availability of acorns in a forest. A reduction in the number of bur oak trees in Iowa's forests caused by bur oak blight will affect a wide variety of game and non-game species of wildlife.

A primary fall and winter food for deer is acorns, composing around 54% of a deer's yearly diet. It has been estimated that in order to fulfill the needs of forest wildlife, 20 mast producing trees are necessary per acre. The number of trees per acre to produce an adequate supply of acorns for forest wildlife will depend on the population of forest wildlife, weather, the size, age and health of those mast producing trees.[22]

In addition to being a source of food, bur oaks are currently a significant part of the largest forest type in Iowa. There are approximately 150,000 wild turkey and 400,000 deer that depend on forests for cover and search out oaks for mast before winter. If bur oak suffers the same fate from bur oak blight that elm

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[20] Pullis La Rouche, Genevieve. *Birding in the United States: A Demographic and Economic Analysis*. Publication. Washington, D.C.: U.S. Fish and Wildlife Service, 2003. Print.

[21] <www.fnr.purdue.edu/inwood/past%20issues/HowtoManageOakForestsforAcornProduction.htm>. Sept. 27 2010.

[22] <http://mdc.mo.gov/landwater-care/animal-management/deer-management/planning-ahead-wildlife-survival-white-tailed-deer->. Sept 27 2010.

suffered from Dutch elm disease, there will be a lot less suitable habitat for birds, wild turkey and deer. The loss of bur oak within the oak-hickory forest type will negatively impact the economic contribution of $1.5 billion that fish and wildlife recreation provides to Iowa's economy.

Economic Impacts

We can estimate the economic impact of bur oak blight to the wood products industry in Iowa based on current harvesting rates. The next table shows the economic impact harvesting bur oak has annually at current harvesting rates and prices to forest landowners, loggers and sawmills.

Annual Statewide Wood Products Loss

Annual Volume Harvested (bdft)	992,457[23]	Sawlogs
Estimated Economic value to Landowners	$297,737	Assuming $0.3/ bdft profit
Estimated Economic value to Loggers	$297,737	Assuming $0.3/ bdft profit
Estimated Economic value to Mills	$297,737	Assuming $0.3/ bdft profit
Total Direct Economic Impact	$893,211	
Indirect Economic Impact	$446,606	Assuming 50% based on IMPLAN
Total Economic Impact	**$1,339,817**	

Based on 2008 estimates, Iowa had 1.1 billion board feet of merchantable size bur oak growing within 3 million acres of forest. The potential loss of income of this readily available resource to Iowa forest landowners is summarized in the table on the following page. This is the estimated timber value of the bur oak resource that exists today in Iowa's forests.

Statewide Landowner Value

Total Merchantable Volume (bdft)	1,100,000,000[24]	Sawlogs
Estimated Economic value to Landowners	$330,000,000	Assuming $0.3/ bdft profit
Estimated Economic value to Loggers	$330,000,000	Assuming $0.3/ bdft profit

[23]Miles, P.D. Forest Inventory EVALIDator web-application version4.01 beta. St.Paul, MN:U.S. Department of Agriculture, Forest Service, Northern Research Station. September 27, 2010 http://fiatools.fs.fed.us/Evalidator4/tmattribute.jsp

[24] Miles, P.D. Forest Inventory EVALIDator web-application version 4.01 beta. St.Paul, MN:U.S. Department of Agriculture, Forest Service, Northern Research Station. September 27, 2010 http://fiatools.fs.fed.us/Evalidator4/tmattribute.jsp

Estimated Economic value to Mills	$330,000,000	Assuming $0.3/ bdft profit
Total Direct Economic Impact	$999,000,000	
Indirect Economic Impact	$499,500,000	Assuming 50% based on IMPLAN
Total Economic Impact	**$1,498,500,000**	

Tree canopy for Iowa communities averages 12%.[25] Losses from affected urban trees include the cost of removing the tree, its "landscape value" and the cost of replacing that tree. Landscape value is a catch-all term that includes everything from a tree's aesthetic value to its impact on property values, pollution removed from the environment and utility costs. Losses from affected urban trees are not annual, but rather a one-time phenomena, although spread out over many years. These numbers assume residential trees on private property represent the same percentages for bur oak as is being documented during street tree inventories. Community street tree inventories do not take into account bur oak occurring in city parks and other urban areas or on private residential areas. Communities and homeowners will bear the cost burden of removing dead trees caused by bur oak blight.

Statewide Urban Tree Loss

Number of Bur Oak Trees[26]	702,000	Based on 26 million urban trees[27]
Removal Costs[28]	$351,000,000	$500/ tree
Landscape Value[29]	$157,248,000	$224/ tree annually
Replacement Cost[30]	$2,770,092,000	$3,946/ tree at the current size
Total Economic Impact	**$3,278,340,000**	

To determine the total economic impact to the wood products industry, annual industry losses are calculated in the table below using existing harvesting rates. Little is known about the how fast bur oak blight will cause its host to die. There are not any known viable treatments to help trees in forested areas at this time. Assuming this disease takes 20 years to infect every bur oak tree in Iowa, we can estimate losses by determining the net present value (NPV) of each year's impact. NPV translates future dollars into today's dollars, using a discount rate. One way of thinking about NPV is to imagine paying for future losses by putting some money in the bank today. For example, putting $100 in the bank today at a 5% interest rate could pay for $105 in damages next year.

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[25] Nowak, David J.; Greenfield, Eric J. 2010. Urban and community forests of the North Central West region: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota. Gen. Tech. Rep. NRS-56. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 70 p.

[26] Iowa community Forestry Tree Inventories, 23 communities, average number of street trees.

[27] Nowak, David J.

[28] Average removal and stump grinding costs, communication with Iowa arboriculture industry.

[29] Estimated using i-Tree STRATUM Analysis

[30] Estimated using i-Tree STRATUM Analysis

Net Present Value Calculation of Loss of Bur Oak over the next 20 years in Woodlands; assuming 5% discount rate and indirect impact rate of 50%.

Year	**Wood Products Industry** (Future Dollars)	**Present Value** (2010 Dollars)
2010	$ 66,991	$ 66,991
2011	$ 133,982	$ 127,602
2012	$ 200,973	$ 182,288
…..	**…..**	**…..**
2028	$ 1,272,826	$ 528,886
2029	$ 1,339,817	$ 530,211
Total (during spread)		$ 7,804,310
Years 2030 on (Total)	$ 11,916,393	$ 10,099,258
Total Present Value of the loss		**$ 17,903,569**
Discount Rate		5%
Total Annualized Value of the Loss		**$ 895,178**

Conclusion

Under these assumptions, the total impact of Bur Oak Blight to Iowa's wood products businesses is almost **$18 million** or an annualized loss of close to **$1 million** in 2010 dollars for now into perpetuity for Iowa's economy. The result changes with the discount rate (for example, the total present value of losses go up if the discount rate goes down to the current Federal Funds rate target of 0.25%). Additionally, other economic losses would include non-timber products like nut production, reduced wildlife habitat and a **$3.3 billion** loss of services from community trees. Job losses associated with this economic impact were not calculated because of access restrictions to that data. If Iowa can slow the spread, or find a solution to stop the spread of Bur Oak Blight – losses to homeowners, wildlife, forest landowners and the wood products industry can be mitigated.

Dr. Thomas Harrington at Iowa State University is looking for leaf samples of bur oak blight from across Iowa and in neighboring states. Late season (August and September) appearance of necrosis (browning) of the main veins of leaves is the best symptom. Anthracnose may also result in veinal necrosis of bur oak leaves, but anthracnose begins much earlier in the season. Substantial leaf mortality is evident with BOB, and symptoms are usually more severe on the bottom half of the affected tree crowns. No other oak species are affected.

If you have potential BOB material, please contact Dr. Thomas Harrington at tcharrin@iastate.edu or 515-294-0582 for instructions or questions. A photograph may help diagnosis. A permit for shipping samples across state lines can be sent to you.

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"Planning Ahead for Wildlife Survival: White-Tailed Deer Management | MDC." *MDC |*. Web. 27 Sept. 2010. <http://mdc.mo.gov/landwater-care/animal-management/deer-management/planning-ahead-wildlife-survival-white-tailed-deer->.

Pullis La Rouche, Genevieve. *Birding in the United States: A Demographic and Economic Analysis*. Publication. 1st ed. Vol. 2001. Washington, D.C.: U.S. Fish and Wildlife Service, 2003. Print.

Potential Economic Loss Associated with the Introduction of Thousand Cankers Disease of Black Walnut into Iowa

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Bob Atchison, Rural Forestry Coordinator, Kansas Forest Service, KSU
Aron Flickinger, Special Projects Forester, Iowa DNR
E.M. (Ted) Bilek, Ph D, Economist, USDA FS, FPL, Economics and Statistics Research

Background

Since the 1990's black walnut has been dying in Western U.S. (CO, NM, AZ, UT, ID, CA and OR). The deaths are caused by a walnut twig beetle (*Pityophthorus juglandis*) that carries a fungus (the proposed scientific name is *Geosmithia morbida*) which is spread as the beetle tunnels through tree tissue. Beetles can reach very high populations and numerous cankers can develop. Instead of one large girdling canker, tree decline and death appears to result from the high number of cankers (causing the creation of the name Thousand Cankers Disease, TCD). Initial symptoms involve yellowing and thinning of the upper crown, which progresses to include death of progressively larger branches. During the final stages large areas of foliage may rapidly wilt.

The disease complex has been discovered as close to Iowa as Rocky Ford, Colorado and most recently in Knoxville, TN. The introduction of TCD into Iowa could have disastrous effects economically and environmentally to the wood industry in the state and the rest of the nation. Iowa has the second largest volume (420 million board feet) of sawlog size black walnut in the U.S. Some experts believe that TCD has the potential to decimate black walnut in the same way Dutch elm disease, emerald ash borer and chestnut blight have destroyed their respective hosts. In preparation for such a potentially devastating attack it is necessary to estimate potential economic losses to support policies and quarantines to slow and

hopefully prevent the introduction of TCD to Iowa and the native range of black walnut.

Control

Controls for TCD have not yet been identified and their development will require better understanding of the biology of the walnut twig beetle and the fungus. Because of the extended period when adult beetles are active, insecticide spray applications will likely have limited effectiveness. Furthermore, colonization of the bark and cambium by the fungus may continue even if adult beetles or larvae are killed by the insecticide. Colonization will likely limit the ability of systemic insecticides to control transmission of the fungus to new hosts before substantial infection occurs. Rapid detection and removal of infected trees currently remains the primary means of managing TCD. Stopping or slowing its spread from infested areas relies on quarantines of wood products and public education.

Geosmithia canker on black walnut twig
March 19, 2010

Economic Impacts

Using existing data from Forest Inventory and Analysis plots, Timber Product Output surveys, and the most recent street tree inventories, we can estimate the potential economic impact of TCD in Iowa. The economic impacts of TCD would occur in four areas, 1) loss to the wood products industry as trees die, 2) loss to forest landowners with black walnut trees on their property, 3) loss to the nut industry, and 4) the loss to communities as street trees die.

The annual impact to the wood products industry includes foregone payments to landowners and loggers, and the lost value added at sawmills. In addition, these losses will lead to further effects throughout the economy, as landowners, loggers and mill operators have that much less economic stimulus not only in the

direct community but eventually worldwide. (This "indirect" effect was calculated using IMPLAN[31] software, data and models.) These are annual losses that the Iowa economy would forgo in the future based on the amount of black walnut that is being harvested annually in Iowa.

Annual Statewide Wood Products Loss

Annual Volume Harvested (bdft)	6,714,000	sawlogs[32]
Estimated Economic value to Landowners	$20,142,000	Assuming $3.00/ bdft profit
Estimated Economic value to Loggers	$6,714,000	Assuming $1.00/ bdft profit
Estimated Economic value to Mills	$6,714,000	Assuming $1.00/ bdft profit
Total Direct Economic Impact	$33,570,000	
Indirect Economic Impact	$16,785,000	
Total Economic Impact	**$50,355,000**	

Based on 2008 estimates, Iowa has 420 million board feet of merchantable size black walnut growing in Iowa's 3 million acres of forest. The potential loss of income of this readily available material to Iowa forest landowners is summarized below. This is the estimated value of the black walnut resource that exists in Iowa today.

Statewide Landowner Value

Total Merchantable Volume (bdft)	420,000,000	sawlogs[33]
Estimated Economic value to Landowners	$630,000,000	Assuming $1.50/ bdft profit
Estimated Economic value to Loggers	$420,000,000	Assuming $1.00/ bdft profit
Estimated Economic value to Mills	$420,000,000	Assuming $1.00/ bdft profit
Total Direct Economic Impact	$1,470,000,000	
Indirect Economic Impact	$735,000,000	
Total Economic Impact	**$2,205,000,000**	

[31] Minnesota IMPLAN Group uses classic input-output analysis in combination with regional specific social accounting matrices and multiplier models.

[32] Miles, P.D. Forest Inventory EVALIDator web-application version 4.01 beta. St.Paul, MN:U.S. Department of Agriculture, Forest Service, Northern Research Station. July 27, 2010 <http://fiatools.fs.fed.us/Evalidator 4/tmattribute.jsp>

[33] Miles, P.D. Forest Inventory EVALIDator web-application version 4.01 beta. St.Paul, MN:U.S. Department of Agriculture, Forest Service, Northern Research Station. July 27, 2010 <http://fiatools.fs.fed.us/Evalidator 4/tmattribute.jsp>

The annual impact to the nut industry includes foregone payments to nut gatherers, and the lost value added at the processor. Again, these losses will lead to further effects throughout the economy and are annual losses that the Iowa economy would forgo every year into the future. Over the last 9 years, Iowa nut producers have sold an average of over 200,000 pounds of walnut seed. In addition to seed for food sources, seed is purchased for reforestation efforts. Both of these markets are combined for the analysis in the chart below.

Annual Statewide Nut Production Loss

Annual Value Harvested[34]	$50,000
Direct Economic Impact	$50,000
Indirect Economic Impact	$25,000
Total Economic Impact	**$75,000**

Tree canopy for Iowa communities averages 12%. Losses from affected urban trees include the cost of removing the tree, its "landscape value" and the cost of replacing it. Landscape value is a catch-all term that includes everything from a tree's aesthetic value to its impact on property values, pollution removed from the environment and utility costs. Losses from affected urban trees are not annual, but rather a one-time phenomena, although spread out over many years. These numbers assume residential trees on private property represent the same percentages for black walnut as is being documented during street tree inventories. Community street tree inventories do not take into account black walnut occurring in city parks and other urban areas or private residential areas.

Statewide Urban Street and Park Tree Loss

Number of Black Walnut Trees[35]	1,014,000	
Removal Costs[36]	$507,000,000	$500/ tree
Landscape Value[37]	$200,772,000	$198/ tree annually
Replacement Cost[38]	$2,677,974,000	$2,641/ tree at the current size
Total Economic Impact	**$3,385,746,000**	

[34] Personal communications with Hammons Products Company and State Forest Nursery.

[35] Iowa Community Forestry Tree Inventories, 23 communities, average number of street and park trees.

[36] Average removal and stump grinding costs, communication with Iowa arboriculture industry.

[37] Estimated using i-Tree STRATUM Analysis

[38] Estimated using i-Tree STRATUM Analysis

To determine the total economic impact, annual industry losses are calculated in the table below using existing harvesting rates. Little is known about the spread of TCD and it is impossible to estimate when it will arrive in Iowa. (Indeed, since TCD symptoms may be invisible for several years, TCD may already be in Iowa.) Assuming that TCD arrives next year and that the losses are spread out over 20 years, we can estimate losses by determining the net present value (NPV) of each year's impact. NPV translates future dollars into today's dollars, using a discount rate. One way of thinking about NPV is to imagine paying for future losses by putting some money in the bank today. For example, putting $100 in the bank today at a 5% interest rate could pay for a $105 in damages next year.

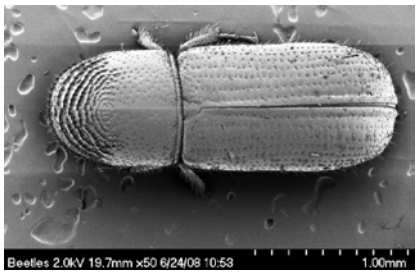
Net Present Value Calculation of Loss of Black Walnut over the next 20 years in Woodlands; assuming 5% discount rate and indirect impact rate of 50%.

Year	**Wood Products Industry** (Future Dollars)	**Present Value** (2010 Dollars)
2010	$4,531,950	$4,531,950
2011	$9,063,900	$8,632,286
2012	$13,595,850	$12,331,837
…..	**…..**	**……**
2028	$86,107,050	$35,779,258
2029	$90,639,000	$35,868,930
Total (during spread)		**$527,963,815**
Years 2030 on (Total)	$30,213,000	**$683,217,717**
Total Present Value of the loss		**$1,211,181,531**
Discount Rate		5%
Total Annualized Value of the Loss		**$60,559,077**

Conclusion

Under these assumptions, the total impact of TCD to Iowa's wood products businesses is over **$1.2 billion** or an annualized loss of **$60 million** in 2010 dollars for now into perpetuity for the Iowa's economy. The result changes with the discount rate (for example, the total present value of losses go up if the discount rate goes down to the current Federal Funds rate target of 0.25%). Additionally, economic losses would be **$75,000** for non-timber products like nut production and **$3.4 billion** for community trees. Job losses associated with this

economic impact were not calculated because of access restrictions to that data. If Iowa can delay, or even stop the spread of TCD – losses farther in the future are worth less today. If you are experiencing declining black walnut trees on your property, contact your local district forester to assess the health of those trees.



The twig beetle, (*Pityophthorus juglandis*), that carries Geosmithia morbida, is the tiny vector for TCD.

For additional information about TCD:

http://www.ksda.gov/plant_protection/content/350/cid/1615
http://mda.mo.gov/plants/pdf/tc_pathwayanalysis.pdf
http://www.plantmanagementnetwork.org/php/elements/sum.aspx?id=8033&photo=4600
http://mda.mo.gov/plants/pests/thousandcankers.php

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Forest Tent Caterpillar 2010:

Iowa DNR started receiving reports of forest tent caterpillars in Northeast Iowa in late may. Forest tent caterpillars are commonly found throughout the United States and have regional outbreaks every 6 to 16 years. This was an outbreak year for Allamakee, Winneshiek, Clayton, Fayette, Dubuque, and Delaware counties.

The caterpillars feed on the foliage of sugar maple, aspen, oaks, birch, cherry, basswood, ash, and willow in Iowa. The defoliation can last up-to 3 years before a natural population crash occurs. Extreme cold temperatures and several species of flies and wasps help keep this pest under control. Control measures are typically not needed for this pest, and none were utilized during the 2010 season. The populations will be monitoring over the next several years to ensure that the populations of the caterpillar stay in control. Please report any additional finding in 2011 to Tivon Feeley.

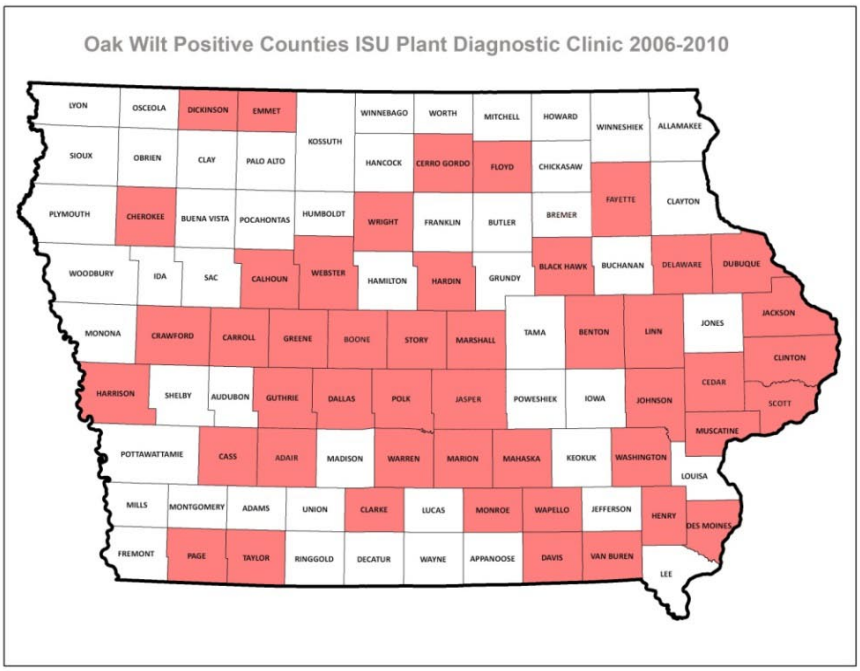
Oak Wilt 2010

Oak wilt has probably been a part of our forests in Iowa for over 100 years. Oak wilt is widespread throughout Iowa's oak resource. Oak wilt is caused by a fungus, *Ceratocystis fagacearum* that invades the water-conducting vessels. As water movement within the tree is slowed, the leaves wilt and drop off the tree. These trees drop their leaves rapidly in late June and throughout September.

Most red oak (red and pin) will die within several months of infection and the white oak (bur and white) decline over several years until either oak wilt or secondary pest kill the tree. Oak wilt can spread overland via sap-feeding beetles or below ground through roots that have grafted together with another oak. In the spring, fungal mats (small masses of *Ceratocystis fagacearum*) develop under the bark of infected trees that died from oak wilt the year before. These mats force the bark to crack open. The fungus produces a sweet odor that attracts sap-feeding beetles on the mats. The beetles then fly to healthier oaks to feed on sap flowing from fresh wounds, thus infecting healthy trees.

To protect your oak trees from oak wilt, do not prune your trees from March through October, when the oak wilt fungus is not active. If pruning is required to fix storm damage trees or for routine maintenance, the wounds should be treated with an acrylic or lac balsam paint to prevent the fungus from establishing.

The only way to confirm oak wilt in a tree is to culture the fungus. This test can be done at the ISU Plant Diagnostic Clinic. Collect 3 twigs (about 1/2" in diameter and 4" in length) from 3 different branches with wilting leaves. Samples must still have live tissue. Scratch the sample branch with your fingernail. If the wood under the bark is a light color (white to green), the sample is fresh. If the wood is brown or dark, it is too old to be sampled. Wrap the sample in wax paper and keep it cool until you mail it. Mail it to ISU Plant Diagnostic Clinic, 327 Bessey Hall, Ames, IA 50010.



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.

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, again in separate incidents in 2004-05, and again in 2009-2010.

The Iowa Department of Natural Resources (IDNR) did not survey for this in 2010 because there have not been any positive finds in the Midwest. Map 1 in Appendix C shows all the sites surveyed for this disease in Iowa from 2003-2005. U.S.D.A. did follow up on suspects in 2010, and the soil testing showed the area to be negative for SOD.

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 affect 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 were first reported in Iowa, Indiana, and Ohio in the 1980's and more recently in Wisconsin and Minnesota. Tatters have 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 research is focusing 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

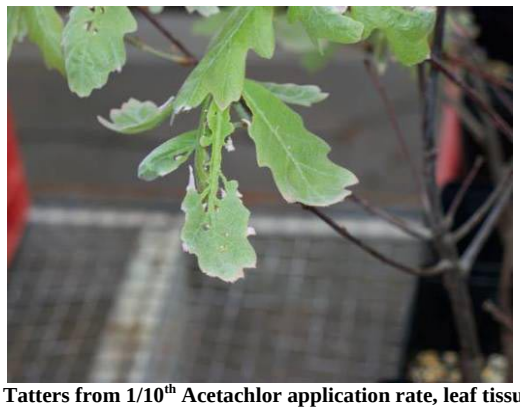
Here in Iowa, IDNR and the U of I Hygiene laboratory decided to collect 14 air, 12 rain water, and 15 oak leaves during a six week period of time to see how the levels of acetochlor varied in relation to the tatters event that was happening. Two urban sites were set-up with these collection stations. The results showed that for a brief period in early spring the rain water samples had trace amounts of a chemical called acetochlor. The trace amounts were just less than 3 grams.

In 2008 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. The 1/100 and 1/10 application rate caused severe tattering at all stages of bud break and leaf expansion as shown in the photos below.

Tatters from 1/10th application rate Acetachlor.

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




Tatters from 1/10th 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 1/100th. Leaves treated at bud break.

Purpling from chlorine treatment.

Cupping from 2-4D treatments.

The same greenhouse treatments continued in 2010 in attempts to quantify the damage done to the white oak trees. The results showed that after 91 days of development 3 gram treatment (1/1000) had a 38.8% reduction in roots, 30 gram (1/100) had a 68.6% reduction in roots, 300 grams (1/10) had a 94.4% reduction in root growth versus the control trees treated with water, chlorine, or 2-4D. The finding is significant and strongly correlated to acetochlor. ISU and DNR have applied for federal funding to look further into how the chemical is injuring trees, other species that may be affected, and how the chemical influences natural regeneration in Iowa's forests.

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.

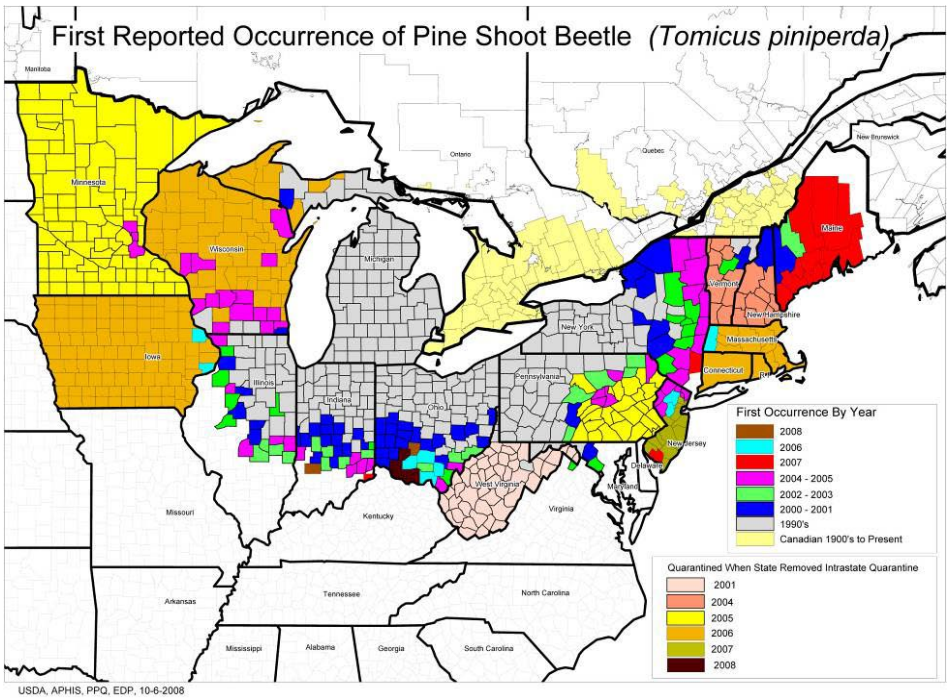
In May, 2006, USDA-APHIS-PPQ confirmed the presence of pine shoot beetle (PSB) in Dubuque and Scott counties. A Federal Order was issued effective June 22, 2006 placing Dubuque and Scott counties under a Federal quarantine for interstate movement of PSB regulated articles. Iowa Department of Agriculture 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, 515-251-4083, 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, 515-251-4083, 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, 11213 Aurora Ave, Urbandale, IA 50322, or contact USDA-APHIS-PPQ at 515-251-4083. If you think that you will be shipping out of the quarantine area, contact USDA-APHIS-PPQ at 515-251-4083 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
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 Decline and Mortality

UPDATE ON HICKORY DECLINE RESEARCH

Jennifer Juzwik[1], Ji-Hyun Park[2], and Linda Haugen[1]
U.S. Forest Service[1] and University of Minnesota[2], St. Paul, MN
October 2010

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

Research continued through the 2010 field season on the etiology of hickory decline that is characterized by thinning crowns with small, yellow leaves and hickory bark beetle attack on the upper main stem. This research is part of a larger project initiated in 2006 to assess the distribution and determine the cause(s) of Forest Health Monitoring reported decline and death of hickories in the north central and northeastern regions of the USA. A cumulative list of previous reports and presentations can be obtained from the first author (jjuzwik@fs.fed.us); a list of the most recent ones is provided at the end of this report.

Six monitoring plots were established in 2009 to document the rapidity of crown decline or dieback in each of five to eight bitternut hickories per plot. Monitored trees in the four Shawano Co., WI, plots changed from "healthy" crown condition (26 of 28 trees) to severely affected (80 to 99%) between late June 2009 and early September 2010 (see Table 1). Changes in crown conditions of 14 trees in two Menominee Co., WI, plots were less for the same time period.

Pathogenicity trials were conducted in Minnesota and Wisconsin with *Fusarium solani* and *Ceratocystis smalleyi* obtained from actively declining bitternut hickory in those states. The overall goal is to determine the role of selected fungi in the decline and death of hickory. *C.smalleyi* was shown to be a virulent pathogen based on large, elongate cankers found within 14 months of artificial inoculation on poletimber sized bitternut hickory. *F. solani* proved to be a weak pathogen with small cankers produced within 12 months of inoculation.

The interaction between hickory bark beetles (*Scolytus quadrispinosus*) and *C. smalleyi* was investigated. Three actively declining bitternut hickories from two Wisconsin locations were felled and bark stripped from the entire main stem of each. Hundreds of inner bark and sapwood lesions were found on the stems. Over 90% of these were associated with hickory bark beetle attack. The bark beetles emerged from infested trees between late June and late July. *C. smalleyi* was commonly isolated from beetles collected during their construction of entry holes. In contrast, the fungus was seldom (3 of 41) isolated from adults manually

collected from bark beetle galleries on declining trees just prior to beetle emergence. Furthermore, the fungus was not isolated from 40 beetles emerged from logs in rearing tubes. Thus, hickory bark beetles are likely involved in initiation of cankers on beetle colonized stems. It is not clear, however, whether bark beetles only provide the entry hole (i.e. infection court) for the fungus or whether they are vectors as well.

Field studies also were conducted to more precisely determine the role *C. smalleyi* plays in causing hickory decline. The fungus colonizes the sapwood as well as the bark in naturally and artificially inoculated trees. The effect of multiple inoculations (50 per tree between 6 and 12 ft. on main stem) on within tree water transport was evaluated by monitoring sap flow rate and documenting tylose production in the sapwood of trees that had been inoculated 14 months before in two locations. Only one of eight inoculated trees showed any symptoms of decline in the crown when sap flow was monitored; however, extensive, elongate cankers were evident. Bitternut hickory with numerous cankers showed significantly reduced mean sap flow rates compared to non-infected trees ($P = 0.005$) in the 2009 evaluation conducted in southeastern Minnesota (Figure 1). Sap flow rates were inversely related to the extent of inner bark tissue death associated with *C. smalleyi* inoculations ($P < 0.01$) (Figure 2). Lastly, sap flow rates were inversely related to the numbers of tyloses found in xylem vessels of the study trees (Figure 3). A prior anatomical study found that tyloses are produced in response to *C. smalleyi* infection. These preliminary results suggest that multiple stem infections of *C. smalleyi* impair water transport in bitternut hickory. These preliminary findings also support the overall hypothesis that the synergistic interaction of hickory bark beetles and *C. smalleyi* lead to tree decline and mortality.

Conclusions to Date and Future Work

Hickory decline is a complex of diseases rather than a disease complex. The most widespread of the diseases is the one causing rapid crown decline and tree death. Stress events or stand conditions (e.g. drought, flooding, over-topping) predispose trees to hundreds to thousands of hickory bark beetle attacks. Hundreds of main stem cankers result after the pathogen, *C. smalleyi*, is either introduced with the beetle or infects through beetle entry holes. Coalescing cankers and additional attacks by bark beetles coupled with invasion by secondary invaders (e.g flat-headed wood borers) lead to crown decline. Control of hickory bark beetles is the key to managing this disease. Guidelines include management of stand density to reduce stress on trees, management of bitternut hickory abundance in mixed stands to reduce susceptibility to beetle attacks, and appropriately timed removal (sanitation) of beetle attacked trees. Data analyses and final report preparation are currently underway. Publication of these findings will mark the completion of this Forest Health Monitoring (U.S. Forest Service) funded project.

Table 1. Crown conditions of bitternut hickory over time in stands with active hickory decline associated with hickory bark beetles and Ceratocystis cankers.

Location	Plot	June 2009		Early Sept. 2010		Ave. rating
	no.	No. trees	Ave. rating	No. trees	Ave. rating	change
Shawano Co.	1	6	1.0	6	5.0	+ 4.0
WI	2	8	1.6	8	5.4	+ 3.8
	3	7	1.0	7	5.1	+ 4.1
	4	7	1.0	7	4.9	+ 3.9
Menominee Co.	1	6	1.0	5	2.4	+ 1.4
WI	2	8	1.0	8	3.8	+ 2.8

Crown rating system: 1 = dieback or decline < 20%; 2 = 20 to 39%; 3 = 40 to 59%; 4 = 60 to 79%; 5 = 80 to 99%; and 6 = dead crown.

Figure 1. Diurnal patterns of mean sap flow rate (m/hr) over time in *Ceratocystis smalleyi* inoculated and non-inoculated (control) bitternut hickory trees.

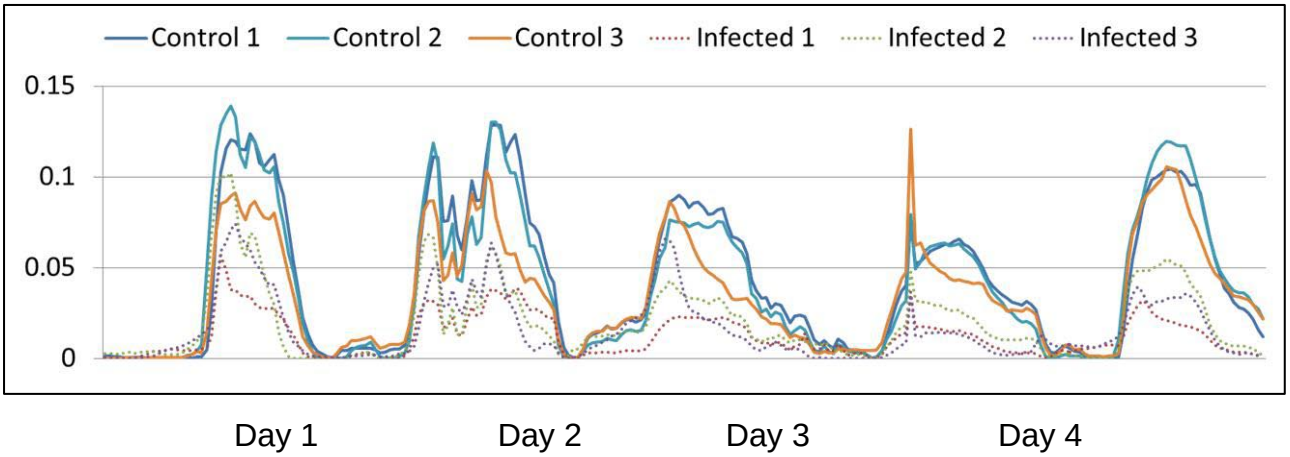


Figure 2. Mean sap flow rate (m/hr) versus proportion of tree stem surface area (between 6 and 12 feet) with necrotic inner bark tissue for both control and *Ceratocystis smalleyi* inoculated bitternut hickories.

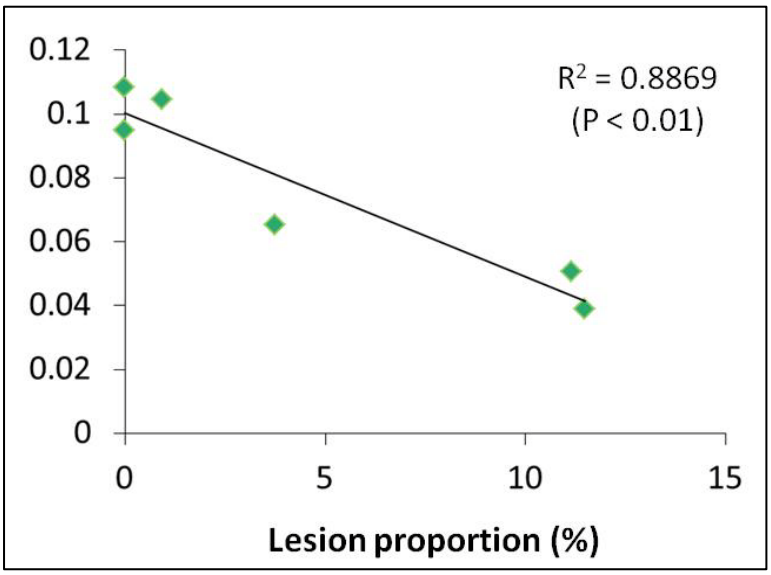
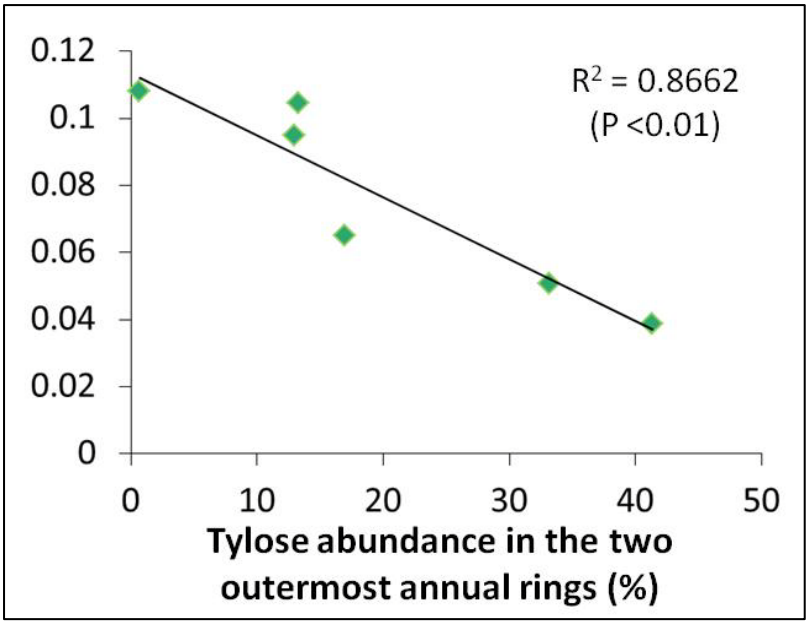
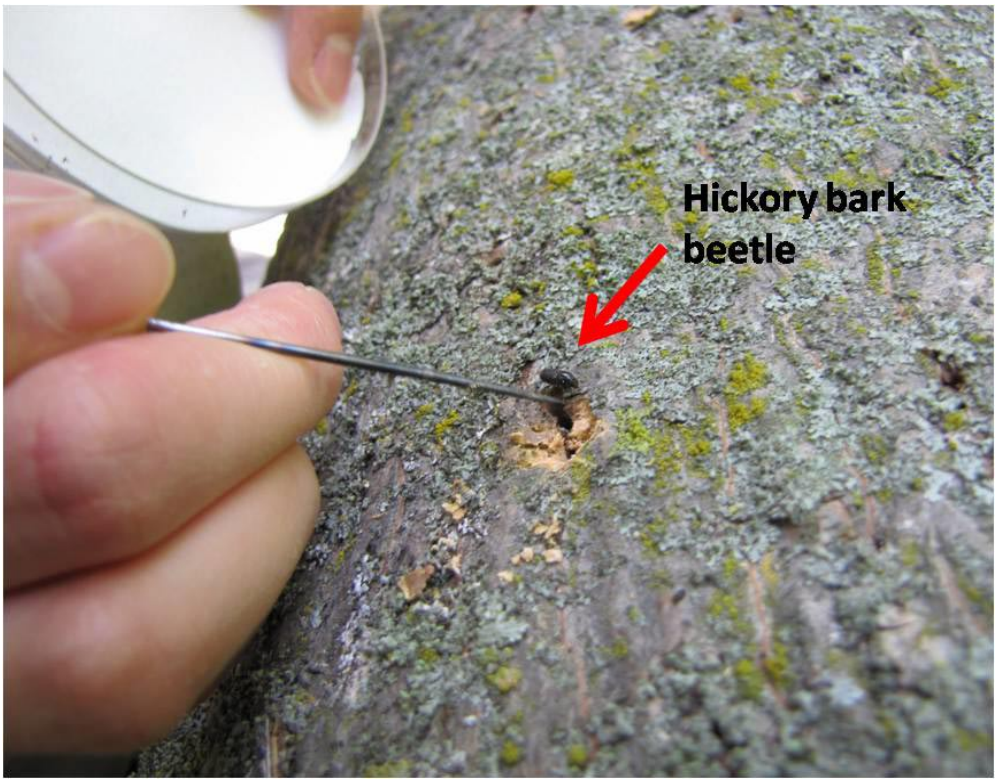


Figure 3. Mean sap flow rate (m/hr) versus numbers of tyloses present in outer sapwood vessels for both *Ceratocystis smalleyi* inoculated and non-inoculated (control) bitternut hickories.



Bark and sapwood lesions were commonly associated with hickory bark beetle attacks.

Hickory bark beetles attacking bitternut hickory in late August and early September 2009 were collected and assayed for presence of *Ceratocystis smalleyi*.



Dutch Elm Disease

Dutch Elm Disease was introduced to North America in the 1930's and began killing millions of native elm trees. Dutch Elm Disease has been identified in all of Iowa's counties, and it's estimated that just over 95 percent of the urban elm trees have succumb to this disease.

Unfortunately, Dutch Elm Disease became famous after devastating our native elm populations. The fungus is native to Asia and was introduced to Europe shortly after World War I. From Europe, it traveled to North America in the 1930's in crates made from infected elm logs. The disease quickly infected elms across the United States since our native elms did not have natural resistance to the introduce pathogen.

It's during this time of year that we are reminded that the disease is still out there; as numerous elms are currently dying in the landscape. This year, Dutch Elm Disease has been very prevalent in the urban landscapes and in our woodlands.

Wilted, bright yellow leaves draw attention to elm trees that are infected and begin to die.

Typically, the topmost leaves start to yellow and eventually turn brown and fall of the tree. Over the next several days, the branches begin to die until the entire tree is killed. This process can take a few weeks or can stretch out over a period of several months.

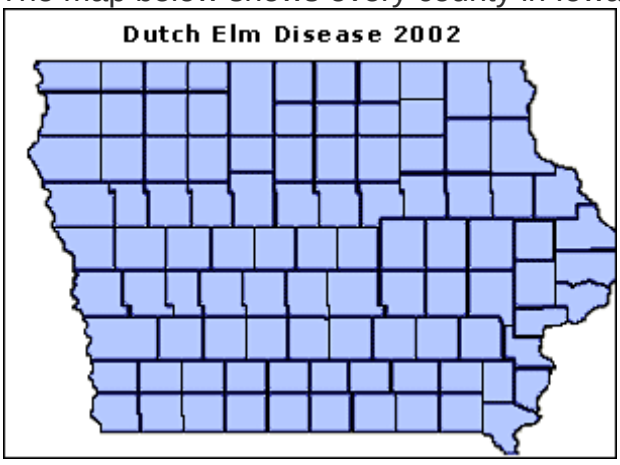
The fungus *Ophiostoma novo-ulmi*, which causes Dutch Elm Disease, finds its way into elm trees two different ways. Elm bark beetles inadvertently carry the fungus on their backs and infect healthy trees when they feed and breed just under the bark. These beetles can move the fungus from diseases to healthy trees over a distance of several miles.

Another way the fungus can infect a healthy tree is through the root system. The roots of elms located within 50 feet each other can root graft together allowing the fungus to travel through the roots systems. Trees that are infected this way usually die quickly.

Once inside a tree, the fungus does its damage by growing inside the water-conducting vessels. This blocks the flow of water to the top of the tree and results in the typical wilting pattern. Although chemical treatments to prevent Dutch Elm Disease work, they have been reserved for the rare specimen tree due to the high cost of semi annual treatments.

There may still be a glimmer of hope for those that want to have native elms as part of their landscape. Researchers have been selecting and developing elms that are tolerant of the disease. Some of these elms are hybrids with Asian varieties, and some are true native American elm that have shown resistance. However, the elms that sprout up in yards and woodlands are extremely unlikely to be resistant and should be managed or removed before they grow into larger shade trees that are expensive to cut down.

The map below shows every county in Iowa had Dutch elm disease since 2002.



Potential Loss of Butternut from Iowa's Forests

Butternut trees produce valuable wood products used for years by carpenters for cabinets, flooring and furniture. It is a softer wood than black walnut, making it easier for woodworkers to shape and carve into products. Butternut grows on a variety of sites, doing best on well-drained soils in riparian areas. Native to the eastern ½ of Iowa and can live up to about 80 years. Like black walnut and oak, it is intolerant of shade, so silvicultural regimes that are suitable for oak and black walnut are appropriate for butternut. Butternut produces seed that is desired by people and many different forest wildlife species.

During the past 40 years, a disease called *Sirococcus clavigignenti-juglandacearum* (butternut canker) has spread throughout the northeastern United States.

The spores of the fungus are spread by rain splash and wind, but the rapid spread of the disease suggests that insects also act as vectors. Dr. Dale Bergdahl and his colleagues have found that at least 17 species of beetles closely associated with butternut that can carry spores of the disease. A single beetle can carry as many as 1.6 million spores (just one is needed to cause an infection) and the spores can remain viable on insects for at least 16 days. The fungus can also be carried on the nut; causing some trees to be infected before they even begin to grow.

There is no known treatment for the butternut fungus, so conservation efforts are focused on finding and protecting resistant trees. A challenge with planting more butternuts is knowing if the trees are genetically pure. Butternuts can hybridize with other trees like Japanese walnut, which was introduced to North America in the 1800's.

Status of Butternut in Iowa

In 1990 Iowa had an estimated 1.4 million butternut trees; by 2008 an estimated 84,000 trees left (94% drop). Of the 84,000 or so remaining no determination of how many of those are hybrids? There are some physical characteristics that

can be used to distinguish between a native butternut and a hybrid, but usually can't use them for mature trees in a forest setting. The trees we are finding in Iowa are being tested using DNA analysis to determine which trees are hybrids and which are native. (Appendix D)

Iowa is in a unique position with respect to the North American butternut range. The eastern half of the state is in the natural range of butternut and the western half is outside of the naturally occurring range.

What are we doing?

Forest Service has made selections of native butternuts throughout the northeastern area over the past 20 years. Branches (scion) are collected from these trees to capture the exact genetics of these desirable trees. Scion has been grafted onto black walnut root stock to help create seed orchards that can produce more seeds to maintain a viable population of native butternut and to test for resistance to butternut canker. The Forest Service selections were made from butternut trees that survived around other butternut trees that died from canker, giving hope that this is a sign of resistance. We have planted 150 of these seedlings in 2007 & 2008 (41 families) in 2 different areas here in the Loess Hills.

In 2009 Iowa along with 4 other states (IN, CT, VT, PA) put together a grant to fund more butternut research. The grant helps to get more butternut surveyed in these states, record with GPS devices the locations of known butternuts, perform DNA testing to determine which trees are native, grafting scion from native selections, perform butternut canker resistance testing through direct inoculations and plant preserves/ orchards of more butternut trees that have the exact genetics of the forest grown survivor trees.

We planted an additional 350 seedlings grown from seed by HTIRC Spring of 2010 from the NA in an effort to continue to preserve more butternut seedlings. It is easier to collect seed from a wide area and grow them in a nursery bed, rather than grafting exact genetics.

Finally, we are continuously following-up on leads of known forest grown butternuts. We have collected seed from 20 different butternut trees and established an orchard here as well. We have used DNA testing to determine which trees are pure and which are hybrid, so far we know we have 12 pure native butternuts and 1 hybrid, with the other trees still needing to be tested. We have another 15-20 butternut trees to visit, collect scion and test for purity this winter.

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, multifora rose oriental bittersweet, and Japanese Knotweed. 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. In 2010, Oriental Bittersweet Japanese Knotweed were identified as upcoming threat to Iowa's Forest Health. A list of invasive plants known to exist in Iowa, and an invasive species risk map is provided in a table located in Appendix E.

In 2009 and 2010, IDNR completed approximately 20 acres of prescribed fires, 20 acres of herbicide control, and 20 acres of hand removal of invasive plants at Backbone State Park and Yellow River State Forest. Although all invasive plants were targeted, the focus was on controlling garlic mustard, honeysuckle, buckthorn, and Japanese knotweed. The project is part of a long term research to determine which option has the most positive impact on the native stands while reducing the invasive plant species and the cost to control them. At this time, both chemical controls and prescribed burns are very effective at controlling invasive plants and similar in costs. However, fire was not a practical management tool for Japanese Knotweed, which tends to grow along streams and very moist sites. This project has shown the best method to control Japanese Knotweed in the stem inject glyphosate into the plant. Past recommendations were to mow Japanese Knotweed and spray the new sprouts with glyphosate. However, it has become apparent that mowing this invasive plant near the streams is a very efficient way to help spread the plant. The is research is ongoing and more updates are expected in 2011.

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 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 Invasive Plant Management on-line textbook
- National Invasive Species Information Center- www.invasivespeciesinfo.gov
- USDA-APHIS web site- www.invasive.org

- Forest Service web site: 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 diversity of tree species with the appropriate number of trees per acre. These simple management plans help prevent a complete loss from a signal pest killing a monoculture and keeps the trees vigor, which may make them more resistant to potential pests. 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.

Iowa's forests are facing an unprecedented level of invasive pests, chemical damage, wildlife pressure, and improper management. Emerald ash borer, gypsy moth, bur oak blight, and thousand cankers disease on walnut could have a 91.6 billion dollar impact on Iowa's woodlands and community trees. 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.

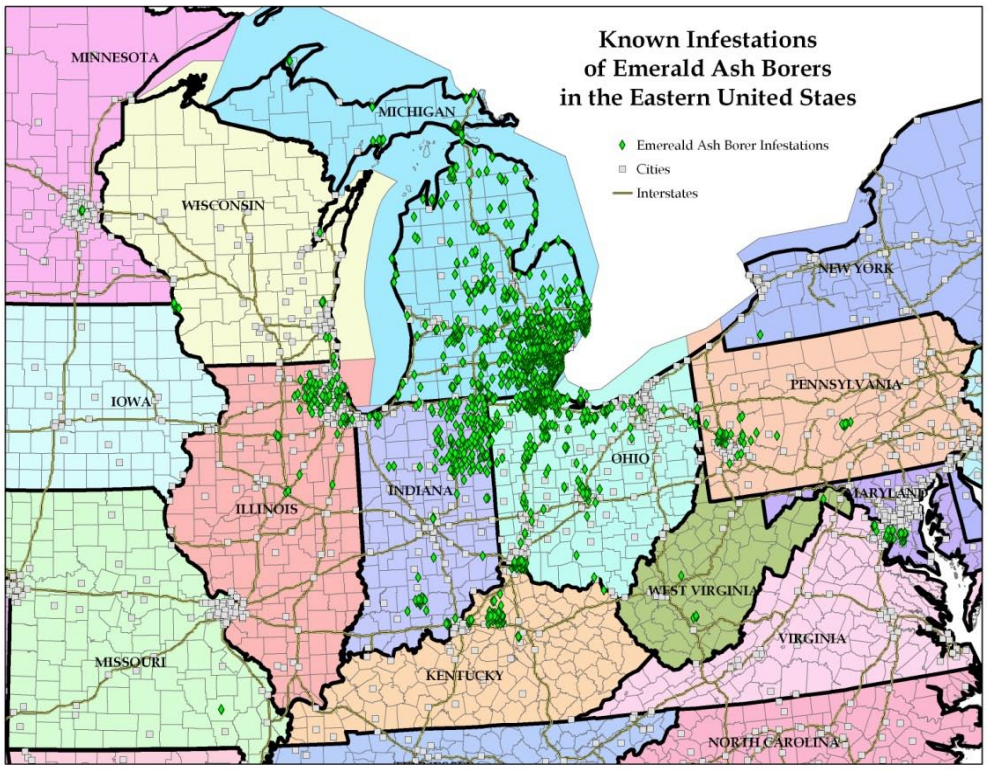
The Bureau of Forestry, through cooperation with other agencies has programs in place to monitor forest stressors which have potential to move into Iowa and damage our forests. Those programs operated vigorously during 2010, and plans are in place for similar, continued vigorous forest health program operations in 2011.

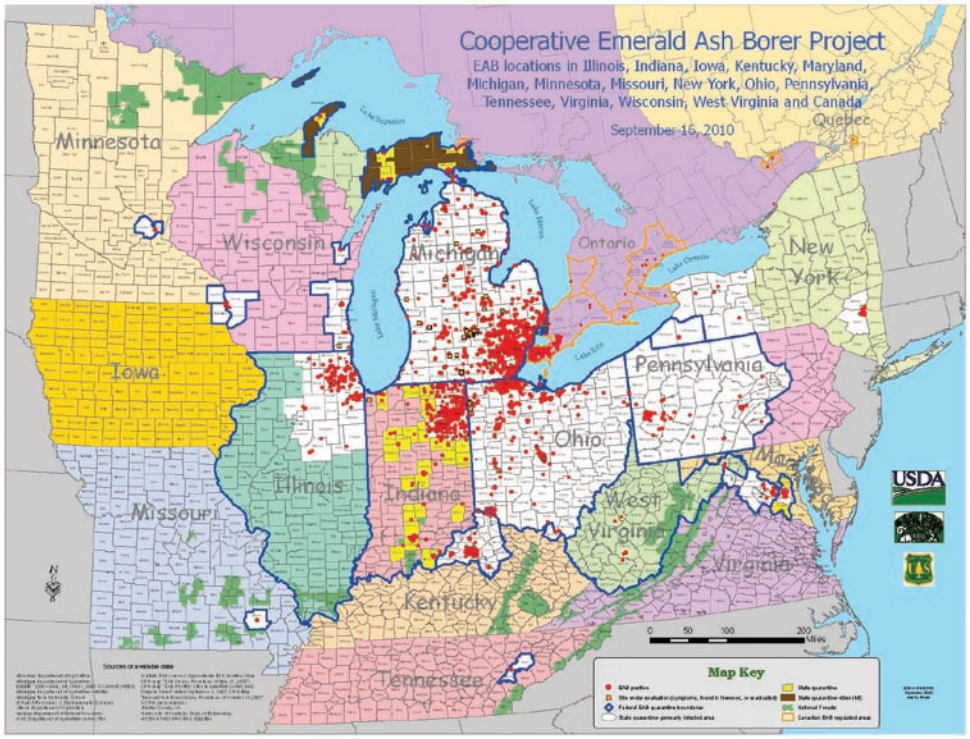
IDNR would like to thank its collaborators from USDA-APHIS-PPQ, Iowa State University Extension, Iowa Department of Agriculture and Land Stewardship, and Department of Natural Resources Foresters.

Appendix A

North America.

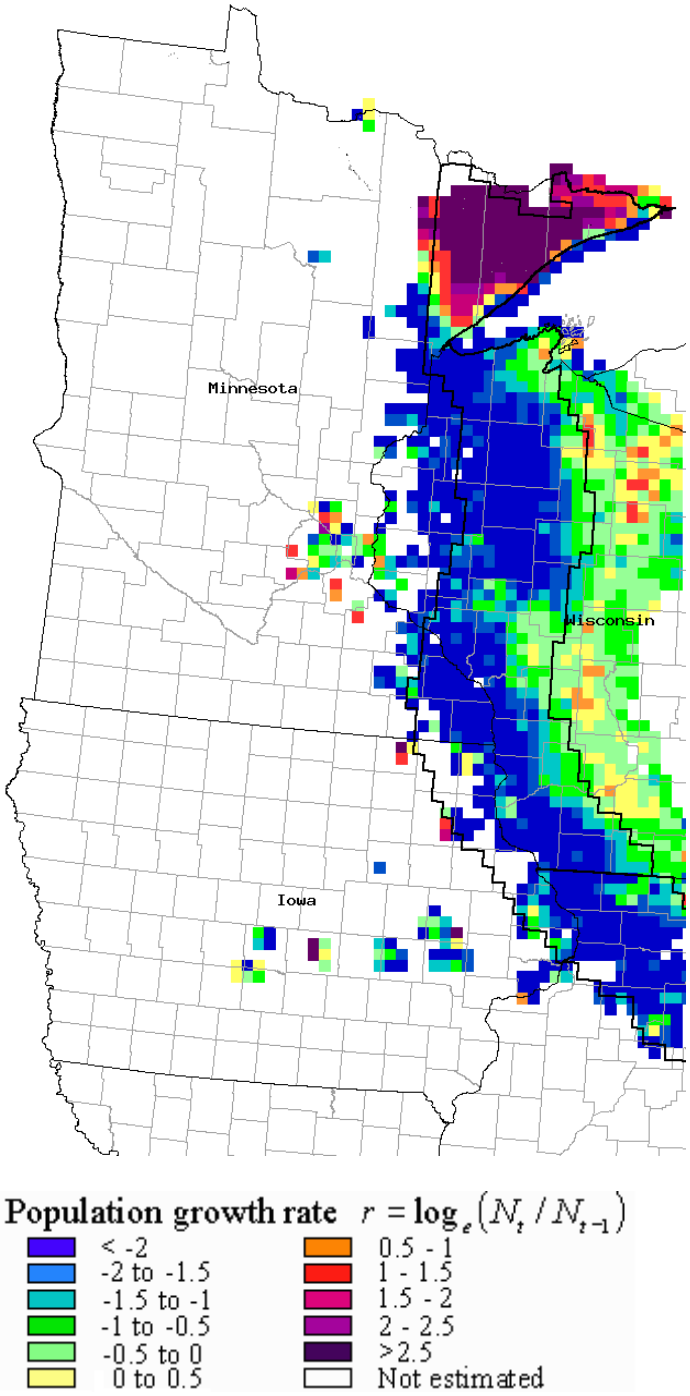
Map 1. Current known Emerald Ash Borer sites as of October 1, 2010.





Appendix B

Map 1. Gypsy Moth Summary Map Showing the population growth rate in the Midwest. See Legend for color definitions. Note the Iowa counties that are now part of the Slow the Spread Program are east of the solid blue line.



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

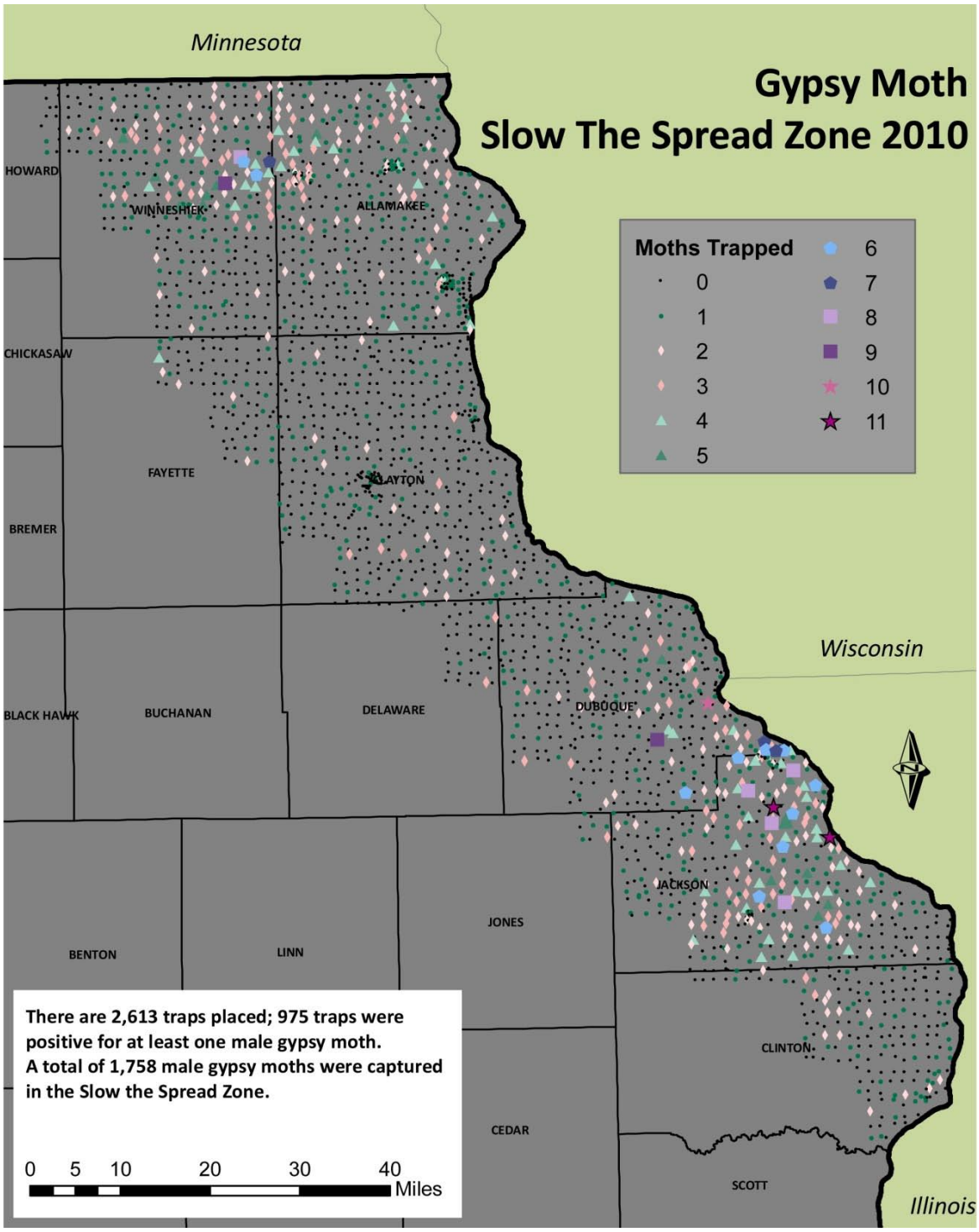
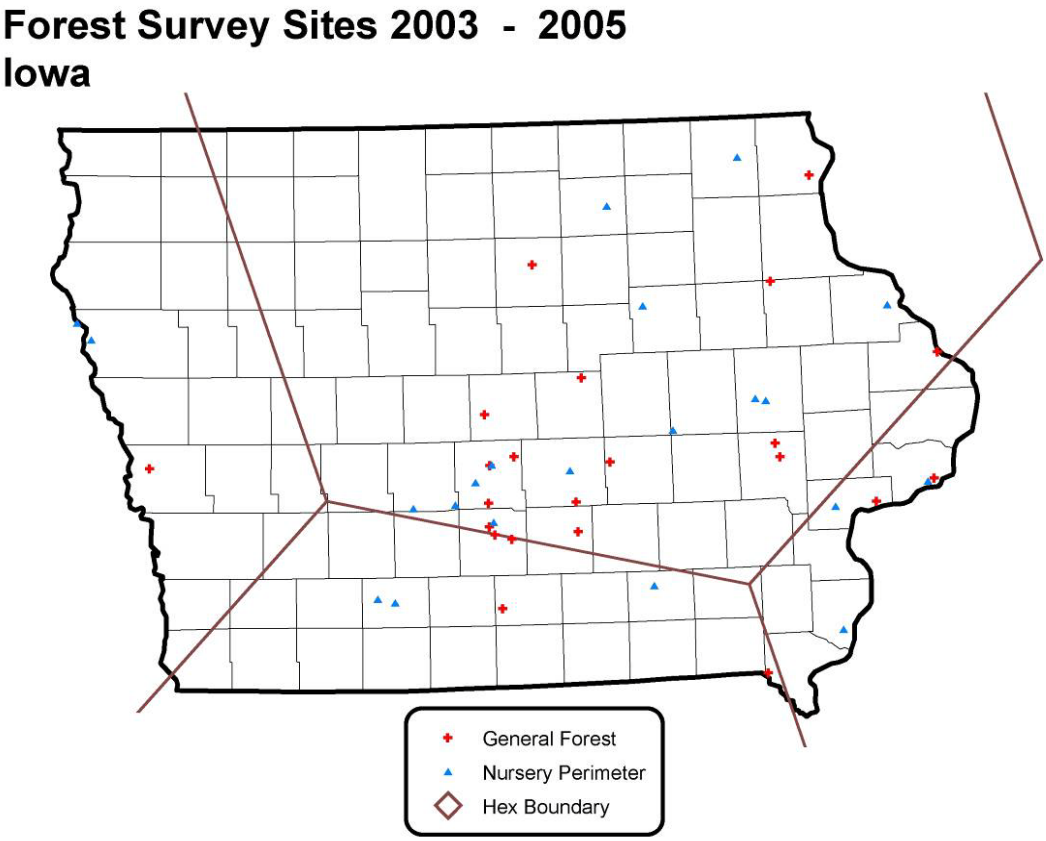


Table 1: History of the Number of Gypsy Moth Catches and the Number of Acres Treated for gypsy moth eradication in Iowa (1972-2010). Unless specified, *Bacillus thuringiensis* var. *kurstak*i was the treatment method.

Year	Number of Traps used in Survey	Number of Traps with 10 Moths or More	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
2009	5217		82	0
2010	5,163	4	2,260	0

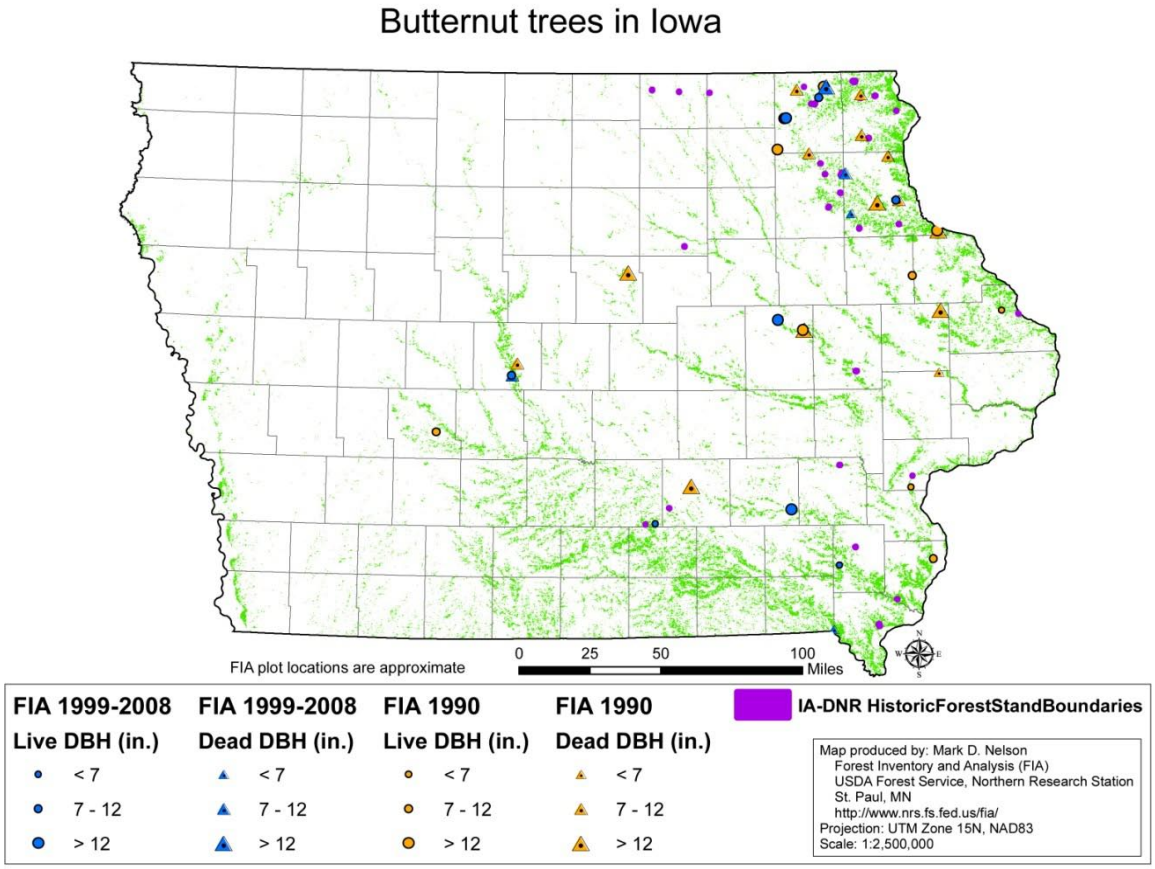
Appendix C

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



Appendix D

Map 2. Summary of Sites Surveyed Butternut.



Appendix E

Known Invasive Plants in Iowa 2010

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

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

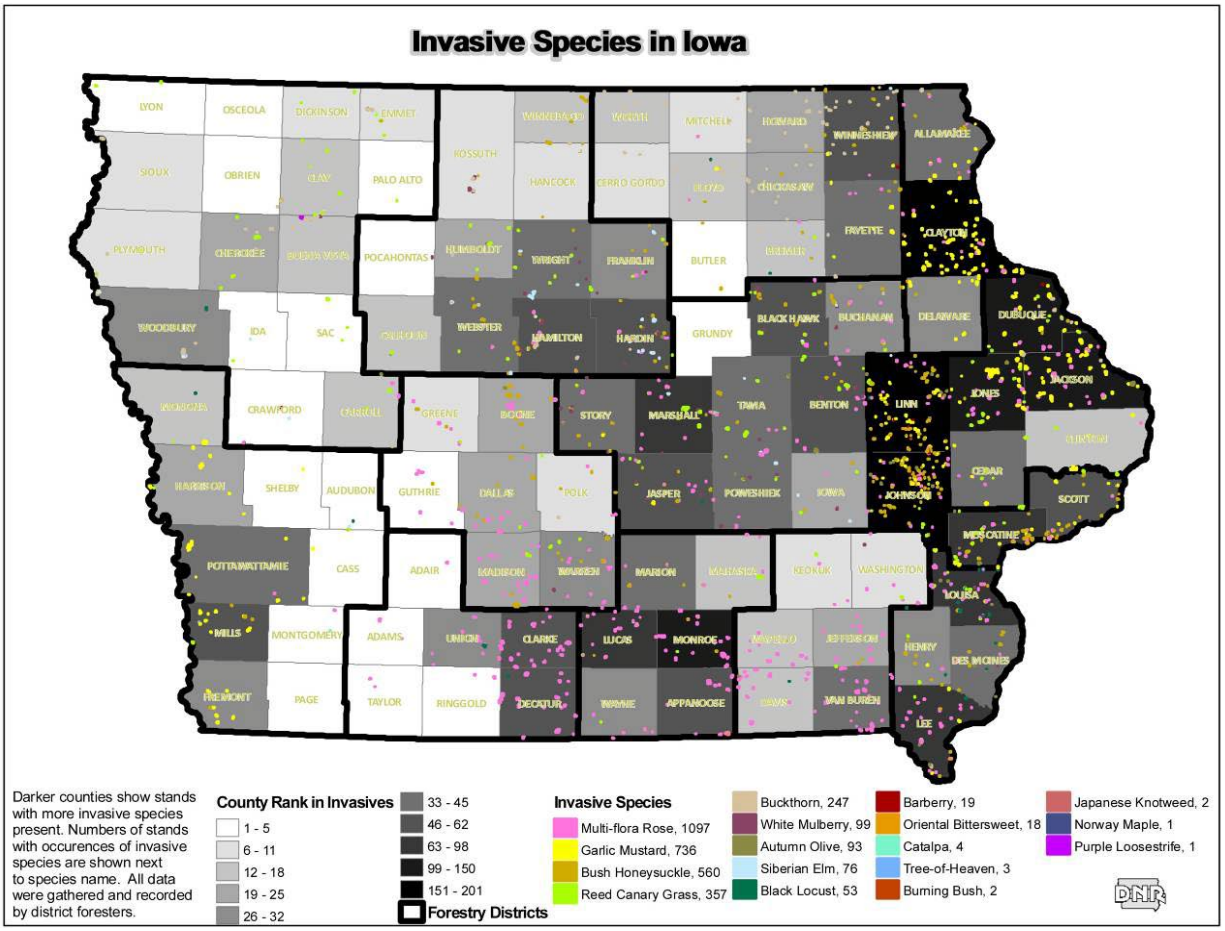
LA= Locally Abundant- the species is present but is not in the majority of the counties

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

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

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

Pictured below are Oriental Bittersweet vines climbing and shading out shade trees. This is an invasive plant that needs to be managed as soon as it is identified, and preferably before it goes to seed. Stay in contact with you District Forester for new management plans. (Pictures from Mark Vitosh, IDNR District Forester).



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Appendix F

USDA Forest ServiceTwenty Major Forest Insects and Diseases List

(This is a national list, pests highlighted in red do not pertain to IA and are not reported on)

Asian long-horned beetle
Beech bark disease
Butternut canker
Dogwood anthracnose- No survey work done in 2010.
Dwarf mistletoes No survey work in 2010.
Emerald ash borer
Fusiform rust No survey work in 2010
Gypsy moth
Hemlock woolly adelgid
Laurel wilt disease/redbay ambrosia beetle
Mountain pine beetle
Oak wilt
Sirex woodwasp
Southern pine beetle
Spruce beetle
Spruce budworm
Sudden oak death
White pine blister rust No survey work done in 2010.
Western bark beetles
Western spruce budworm

Plus:
Tomicus beetle or pine shoot beetle