



# 2006 Michigan Forest Health Highlights

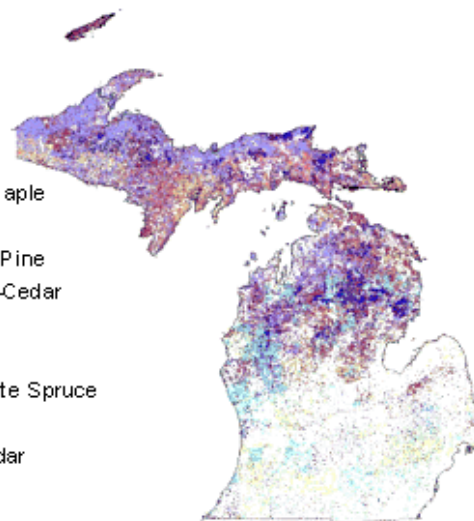
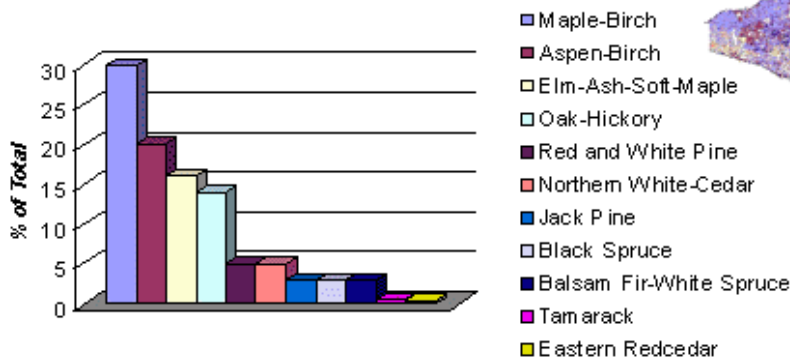
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## Resource Overview

Forests comprise 53% of the land area of the state, or about 19.3 million acres. These forests are a critical component of Michigan's environment and economy for the recreational opportunities and the products they provide. Forestry related industries and manufacturing employ 150,000 people statewide and annually contribute \$9 billion to the state's economy. Additionally, forest-based tourism and recreation support 50,000 jobs and add \$3 billion to Michigan's economy. Michigan's forests contribute to clean air and water and reduce soil erosion.

## Major Forest Types of Michigan



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**FEATURE ARTICLE**

**Michigan's Latest Exotic Forest Pest Threat:  
The Hemlock Woolly Adelgid**

On August 21, 2006 insect samples collected by the Michigan Department of Agriculture (MDA) from a landscape hemlock in Emmet County were identified as Hemlock Woolly Adelgid (HWA). HWA is an exotic invasive insect which feeds on tree sap, killing needles, twigs and branches. Infested trees eventually die. Tree mortality typically takes four to ten years. The adelgid is dispersed by wind and is carried by birds. Because of the critical ecological role played by hemlock in northern forests and the extremely destructive nature of the pest, the HWA stands among the most serious exotic forest insect pests to have ever entered the state.

In 20 years of HWA survey activities this is the third time the pest has been detected in Michigan. The previous two findings in 2001 were restricted to nursery stock which was quickly destroyed. This is the first time that HWA has been found on native hemlock.

Eastern Hemlock (*Tsuga canadensis*) is the second most abundant conifer species in the northeastern United States. Hemlock is a component of 2.3 million forested acres. The most recent survey estimates 102 million trees with a volume of 662 million cubic feet in all size classes. Spectacular hemlocks are valued features of many parks, campgrounds, backyards, travel routes, and Michigan's forested landscapes. The ecological importance of eastern hemlock is matched by few other tree species. Hemlock forests are correlated with high black bear densities. Streams draining hemlock forests have an average of four times the number of brook trout that streams draining hardwood forests. Hemlocks provide important thermal cover for overwintering deer. Three species of songbirds are known to nest only in hemlock. Eastern hemlock is an essential component of Michigan's forest biodiversity, and a universally accepted symbol of Michigan's old growth forests. Lastly, eastern hemlock may take 250 to 300 years to reach maturity and may live for 800 years or more.



Thirty hemlocks were shipped from West Virginia to a local landscaper in 2003. Hemlock in three of four planting sites receiving these trees was infested. MDA staff in cooperation with Michigan State University and the MDNR initiated an intensive, rapid response to this detection. All 30 planted hemlock and adjoining native trees were removed and destroyed voluntarily by the landscaper. The MDA treated a perimeter of hemlock on all four sites with a systemic insecticide in November, 2006, to if efforts to ensure eradication of possible below detection level HWA populations. These sites will be treated again in the spring and fall, 2007. Other hemlock shipments from West Virginia have subsequently been discovered. HWA surveys and responses necessary to protect Michigan's hemlock resources will continue.



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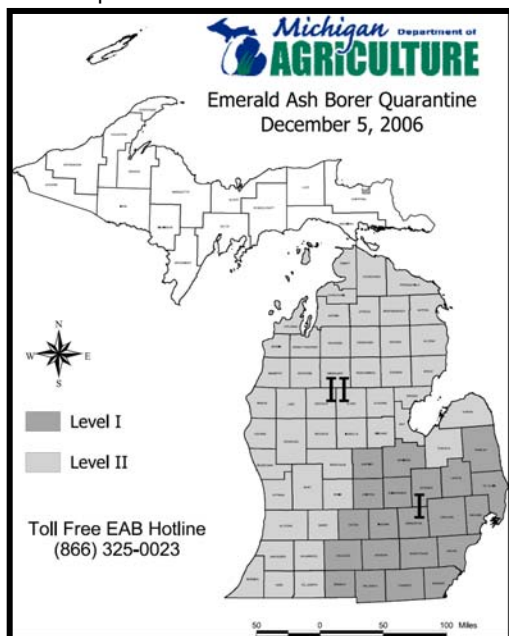
A **Hemlock Woolly Adelgid Quarantine** continues to restrict movement of eastern hemlock into Michigan from infested counties of other states. All eastern hemlock shipments require a phytosanitary certificate. The 2006 detection of HWA in Emmet County underscores the critical need for vigilance when inspecting hemlock and determining the origins of material arriving from out-of-state.

The Michigan Forest Health, Inventory and Monitoring Program completed **Hemlock Woolly Adelgid and Beech Scale Rapid Early Detection Surveys** for the fourth straight year. As a USDA Forest Service funded Forest Health Evaluation Monitoring project. Areas with abundant hemlock near recreation sites and sites adjacent to nurseries were surveyed for presence of HWA. Neighboring beech stands outside of areas known to have beech scale were also surveyed for scale presence. No adelgids and no additional beech scale were found as a result of this survey in 2006.

### **Emerald Ash Borer**

The **Emerald Ash Borer** continued expanding its range in 2006. Infested trees were detected throughout Michigan's Lower Peninsula (LP), the northern 2/3's of Ohio and Indiana, and two locations west of Chicago. The estimates of ash mortality in SE Michigan and northern Ohio continue to increase in increments of millions of trees.

In response to the 2006 EAB detections, as of December 1, 2006, the **Federal EAB Quarantine** was



revised to encompass the entire LP of Michigan, the Brimley site in the Upper Peninsula (UP), Ohio, Indiana and Illinois. The quarantine restricts the interstate movement of regulated articles that originate within a quarantine area. Regulated articles include ash nursery stock and green lumber; any other ash material including logs, stumps, roots, branches, as well as composted and uncomposted wood chips. All hardwood firewood, including ash, oak, maple and hickory are regulated articles.

The **MDA EAB quarantine** was revised on Dec. 5, 2006. All counties in the LP are quarantined. No regulated articles can move from quarantined areas without MDA inspection and approval. There are two levels of quarantine in the Lower Peninsula, levels I & II. This allows the movement of regulated articles within level I & II areas, from level II to level I counties, but not from Level I to level II counties without MDA approval. Visit the MDA website for more information:

<http://www.michigan.gov/mda>

Emerald Ash Borer EAB was not found in Michigan's Upper Peninsula (UP) in 2006. The Michigan Department of Agriculture (MDA) and Michigan Technological University (sponsored by the USDA Forest Service in cooperation with the Michigan DNR) deployed EAB survey traps trees throughout



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the UP ash resource in 2006. The MDA also deployed full time staff at the Mackinac Bridge to enforce the EAB quarantine and educate travelers not to bring restricted materials into the UP. The Michigan DNR conducts **Annual Firewood Sweeps** in December after closure of the firearm deer hunting season. All hardwood firewood left at State Forest Campgrounds & State Parks is burned. This eliminates the risk of EAB emerging from infested firewood the following spring.

Visit the following websites for updates on EAB management, surveys and research:

<http://www.emeraldashborer.info>

<http://www.emeraldashborer.org>

<http://na.fs.fed.us/fhp/eab/>

Regulating the movement of firewood by the public from infested areas remains most difficult of tasks. The message: **DON'T MOVE FIREWOOD!**



### **Emerald Ash Borer – damage surveys**

Since the discovery of **emerald ash borer** in Michigan in 2002, predicting the insect's impact on the ash resource continues to be one of the most important and difficult challenges facing forest health professionals. Estimates of tree and wood volume losses are necessary for planning suppression, restoration and public education efforts, as well as assisting with marketing and wood utilization activities.

Much of the challenge in estimating impact stems from incomplete information about where ash grows in Michigan, particularly in urban and other non-traditional forest landscapes. Information from the Forest Inventory Analysis (FIA) plot network and other forest inventory systems has been useful in determining where and how much ash occurs in Michigan's forests, but information about the location and condition of ash street and landscape trees is limited or nonexistent in most communities. With much of the mortality concentrated in urban and surrounding areas, this information is an important first step in assessing EAB impacts across the landscape.



The short period in late summer when damage is most obvious, air space restrictions over large metropolitan areas and difficulty distinguishing ash from other tree species present challenges to assessing damage using traditional aerial survey methods.

In 2004, MDNR Forest Health Program conducted a damage evaluation survey to assess relative ash condition in the southeastern Lower Peninsula, the area hardest hit by emerald ash borer since its discovery in 2002. The goals of the survey were to:



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- Determine relative density of ash trees
- Determine presence of damaged ash trees
- Determine the presence of dead ash trees
- Develop an ash 'damage index' showing relative distribution of ash damage

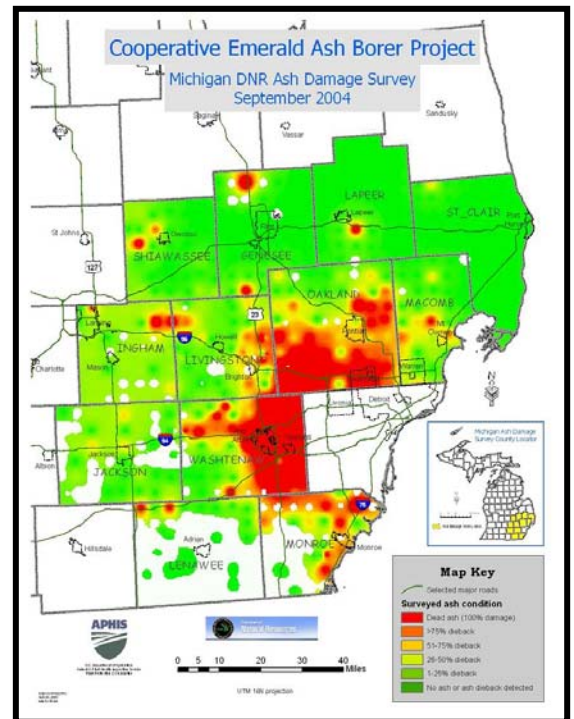
In addition to ash distribution and density data from FIA plots, data was used from ongoing studies being conducted by Michigan State University and University of Michigan. Also, Ash Suitability Zones (ASZ) were developed using soil moisture and nutrient data to predict where ash is most likely to grow on the southern Michigan landscape.

Plots were spaced every 6 km along the quarantine boundary line, as well as within counties adjacent to the line.

A total of 564 plots were established and information was collected about land use, site characteristics, ash density, ash condition and whether signs of EAB were present. All ash within the 'viewscape' of the observer standing at plot center were evaluated.

Information collected in the survey was analyzed by digitally 'stretching' the data across ASZs and weighted as a function of distance from plot center, using 5 damage categories:

An effort is underway at Michigan State University to link information from this survey with data collected from the ASHMAP project. This project collected information about the location and density of ash growing on a variety of landscapes across the southern Lower Peninsula. The objective is to quantify ash condition in terms of trees per acre and tree volume affected.



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## Ash Yellows Project

Michigan State University, in cooperation with the Michigan Department of Natural Resources, has been awarded a Forest Health Monitoring Evaluation Monitoring Program grant to assess decline and contributing diseases, including **ash yellows**, in white ash stands. The 3-year effort will:

- Determine the distribution and severity of ash yellows, root and butt rots in urban, rural and forest ash trees across Michigan.
- Determine the frequency of occurrence of these diseases in forest stands with ash decline.
- Identify risk factors associated with these diseases in forested stands, including stand dynamics, climatic, physiographic and edaphic site factors and stand management history.
  - Evaluate impact of these diseases on radial growth of ash.
  - Quantify relationship between ash decline, ash yellows and various field symptoms, including deliquescent branching, witches'-brooms, basal bark cracks and epicormic sprouts.
  - Assess role of insect vectors in establishment of ash yellows in forested stands.



Ash yellows has been implicated as part of ash decline that is occurring across Michigan. This decline is being documented by the Rural Ash Monitoring Plot System (RAMPS – see article above). This project will incorporate plots from the RAMPS network and use baseline tree- and stand-level information from this system as part of the data collection and analysis protocol. The project will also take advantage of ash distribution information from the ASHMAP system, a USDA Forest Service-funded project begun in 2004 to quantify ash distribution and density in Michigan as part of ongoing emerald ash borer control efforts.



## Rural Ash Monitoring Plots (RAMP) Project

The **RAMP** project has developed a permanent, statewide monitoring plot network in forests containing ash (*Fraxinus* spp.) in order to monitor the status and health of ash in Michigan's rural forests. The goals of this project are 1) to characterize the condition of ash resources in rural forests in Michigan, 2) to characterize forest changes in response to exotic invasive species such as emerald ash borer (*Agrilus planipennis*), 3) to provide a database for use in monitoring and management of ash resources and 4) to provide a network of research plots with data that are available for use in other research projects. Plots are arranged along gradients throughout Michigan as well as in areas not represented along these gradients.

In 2004 and 2005, a total of 73 plots were established in the Upper Peninsula of Michigan. In addition, Michigan Tech field crews and collaborators at University of Michigan have established plots along the other gradients in the Lower Peninsula. A subset of the plots that were established in 2004 was revisited in 2005. All of the plots in Upper Michigan were revisited in 2006. Hence data are available for some plots that were collected in all three years, so the frequency with which plots will be revisited in the future can be evaluated.



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Plot establishment data from the Upper Peninsula have been summarized for tree and stand level data, including diameter, height, age and site index by species and crown light exposure, crown class and tree vigor by species. The majority of ash trees in the Upper Peninsula were characterized as healthy, mature, codominant trees. Very few of the trees were damaged and damage types were not consistent across species or sites. Most damage was recorded as loss of apical dominance.

Analysis of change in tree and stand conditions over the first three years of the project is ongoing. Continued monitoring of these plots will enable us to characterize the impacts of emerald ash borer and other damaging agents on rural forests in Michigan. These plots are also available for use in association with other research projects.

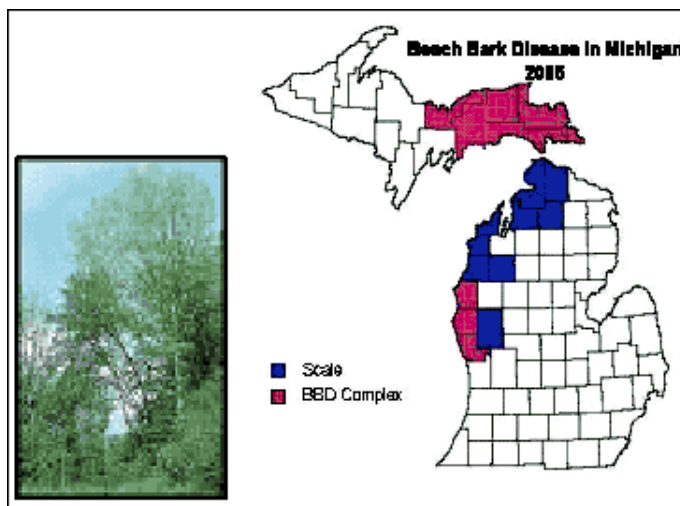
For further information, contact Andrew J. Storer ([storer@mtu.edu](mailto:storer@mtu.edu))



### Beech Bark Disease – Upper Peninsula

Beech scale populations in the Upper Peninsula moved westward to Munising in 2006. Scale populations are building rapidly as the advancing and killing fronts expand in the Upper Peninsula. In killing front areas, forest resource professionals are facing the challenges of salvaging stands before trees die or snap. Hardwood stands with high numbers of beech which historically regenerated naturally after selection harvests now often require tree planting programs to ensure a future, fully stocked, sustainable forest resource. A minor beech component is left in many stands to provide wildlife food & habitat as stands transition to other tree species mixes.

Hazard tree management due to their threat of beech snap and tree mortality is now a fact of life in parks, campgrounds and cities in the Eastern Upper Peninsula



### Beech Bark Disease – Lower Peninsula



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Since the discovery of **beech bark disease** (BBD) in Ludington State Park in 2000, the BBD killing front has expanded very slowly in the west-central Lower Peninsula. Based on data from the **Michigan Beech Bark Disease Monitoring and Impact Analysis System (BBDMIAS)**, a cooperative network of statewide BBD monitoring plots, only Mason, Oceana and Muskegon counties have suffered beech mortality as a result of infection from *Neonectria* fungi, the pathogens responsible for the wood decay and 'beech snap' that occurs in BBD-infected trees.

The BBDMIAS was established in 2002-03 and consists of 202 extensive plots (less detailed information collected) and 62 intensive plots (subset of extensive plots with more detailed information collected). Plots are distributed across 30 counties in the northern Lower Peninsula and Upper Peninsula.

Trends so far include:

- Stands with BBD have lower beech regeneration and lower total regeneration than stands without BBD
- Stands with lower total tree density have higher amounts of beech regeneration and total regeneration
- Beech regeneration and total regeneration are higher in mechanically-thinned stands than in unthinned stands
- No significant difference has been found in ground-dwelling arthropod populations between stands with and without BBD

The BBD advancing front includes forested areas that are infested with beech scale (*Cryptococcus fagisuga* Lindinger) but have not yet been infected with *Neonectria*. Michigan State University, in cooperation with the Michigan Department of Natural Resources Forest Health Program, has estimated beech scale "centers" and scale spread rates based on information collected on the BBD monitoring plots and additional sentinel sites.

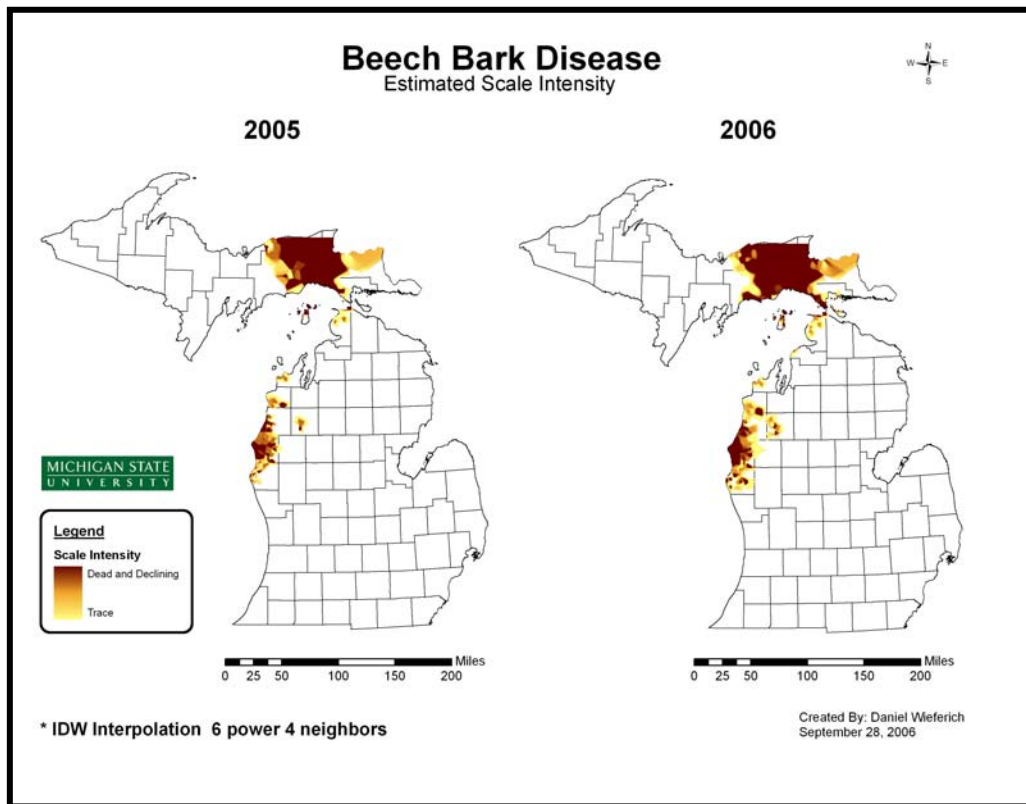
Based on data from these plots, 5 discontinuous scale populations are established in the Lower Peninsula, as well as 3 infested islands in Lakes Michigan and Huron.

Using a rate-of-spread model, the annual spread rate in the northern Lower Peninsula in 2005-06 averaged 1.5 km per year. Empirical data from the 2004-06 field work suggest that spread rates can vary greatly from year to year.



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Plans for 2007 are:

- Expand the BBDMIAS plot network in the Upper Peninsula to determine the rate of beech decline and mortality;
- Expand the BBDMIAS in the Lower Peninsula to determine impacts of beech scale on growth and vigor in scale center outliers beyond the general advancing;
- Continued analysis of site and stand data from the BBD spread-modeling project, including comparison of advancing front spread rates in Michigan with those in the eastern U.S.;
- Development of a computer interface to allow use of the spread model by resource managers.

### Beech Bark Disease Resistance

Scions from **Beech Bark Disease** (BBD) resistant American beech were collected again in 2006 and sent to Dr. Jennifer Koch at the USDA Forest Service Research Facility in Delaware, Ohio. Michigan continues to identify and protect resistant trees within Michigan's BBD killing front areas to contribute to this project.



Six-month old cross-progeny seedlings challenged with 50 egg sac foam pads. (Picture provided by Dr. Jennifer Koch)



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Dr. Koch reports that a hot-callus grafting technique greatly enhanced seed production in 2006. They saw increases from 2005 in both the percent of full seed that was produced on grafted material (66-100%) versus field pollinations (12-39%) as well as increases in the number of full seeds that successfully germinated (germinative capacity).

This new grafting technique allows them to:

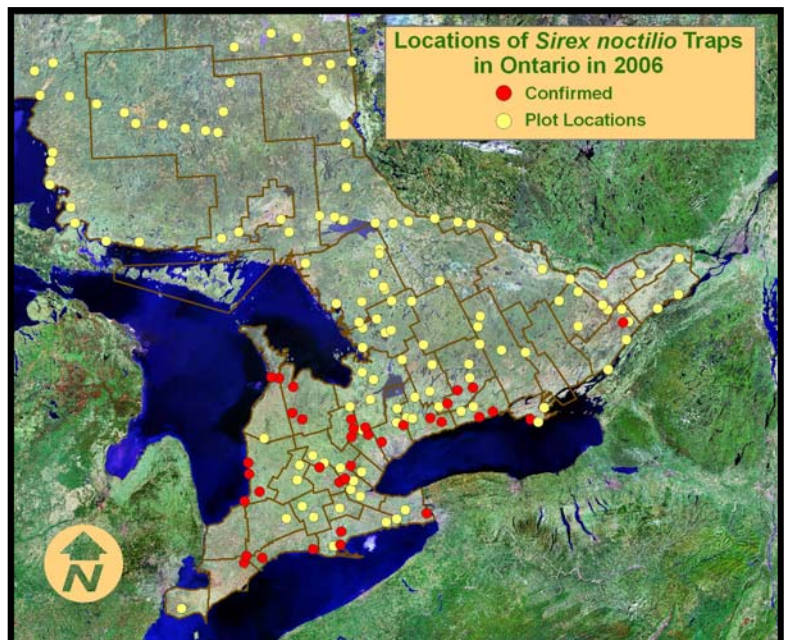
- 1) Efficiently graft, propagate and preserve resistant beech;
- 2) Accelerate the breeding program;
- 3) Use greenhouse pollination to provide resistant seed/seedlings for out planting.

Dr. Koch will germinate collected seeds in the winter of 2007. They expect the R x R crosses to produce at least 50 % resistant offspring. Seedlings produced from these crosses will be insect challenged to determine their resistance phenotype. Michigan is anxious to out plant the resistant seedlings as they become available. We hope to establish seed orchards and to regenerate healthy beech in killing front and aftermath forests.



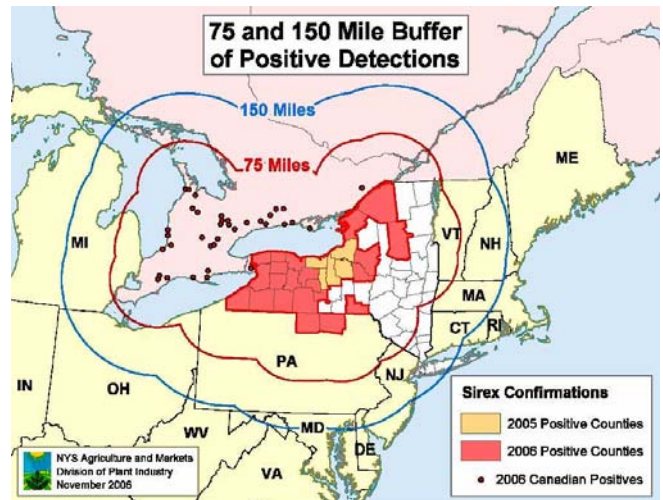
## Sirex Wood Wasp

Since its detection in New York State in 2004, the European wood wasp *Sirex noctilio* has been confirmed at trap sites throughout the eastern Great Lakes region of Ontario, Canada. This exotic wood wasp (also commonly referred to as horntail) is native to Europe, Asia and northern Africa and was collected in Fulton, New York in September 2004. The New York find is the first time the insect has been documented in North American forests. *S. noctilio* is rarely a pest in its native areas where it confines its attacks to dead or dying trees. In areas where it has been introduced, however, it is a major pest of pine plantations, where it attacks living trees and can cause up to 80% mortality. Outbreaks often build up in stressed trees and then spread to more vigorous trees. Widespread outbreaks have occurred in Australia, New Zealand, South Africa



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and South America. In a pest risk assessment for North America it has been rated a “very high risk” pest.



Female *Sirex* horntails are attracted to stressed trees where they insert their sword-like ovipositors into the outer sapwood, deposit their eggs and introduce a toxic mucus and fungus (*Amylostereum areolatum*). Larvae feed only on the fungus, which, together with the mucus, kills infested trees.

Symptoms of *Sirex noctilio* infestation include:



- Exit holes approximately 1/8 to 3/8 inches in diameter;
- Tree crowns turning light green then yellow to reddish brown in the late spring or early summer;
- Larval galleries (tunnels) in the wood, packed with a fine powdery frass (insect-produced sawdust);
- Beads of resin or streams of resin on the bark, exuding from holes created during egg-laying.



Pitch or resin will often weep from the tiny puncture wounds made by the adult females when they lay their eggs. The damage can be very subtle or quite obvious and care must be taken in using this symptom as a feature of fresh attacks.

In Michigan, most 2- and 3-needle pines are considered susceptible, including Scotch, jack, red and Austrian pines.



Beginning in 2006, Michigan participated in a cooperative international detection monitoring program for *Sirex*. Traps were placed in high-risk pine stands in the southeast and north central Lower Peninsula and



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monitored regularly. No *Sirex* wood wasps were collected. Additional traps will be set in 2007.

For more information, link to:

[http://www.na.fs.fed.us/spfo/pubs/pest\\_al/sirex\\_woodwasp/sirex\\_woodwasp.htm](http://www.na.fs.fed.us/spfo/pubs/pest_al/sirex_woodwasp/sirex_woodwasp.htm)



**Ramorum Blight** (formerly known as Sudden Oak Death) (*Phytophthora ramorum*) was not detected in Michigan nurseries, urban forests or forest lands in 2006. The Michigan Department of Agriculture (MDA) conducted surveys for *Phytophthora ramorum* at 33 production nurseries known or suspected to receive nursery stock from California, Oregon, Washington, or British Columbia. Five to twenty leaf samples from a total of up to 20 symptomatic plants were collected at each firm. Sampling was limited to species, cultivars, and varieties of *Rhododendron*, *Pieris*, *Syringa*, *Kalmia*, *Quercus*, and *Viburnum*. Samples were analyzed using ELISA within 48 hours at the MDA Plant Pathology Laboratory. DNA from positive and suspect samples was extracted and submitted to the National Plant Germplasm and Biotechnology Laboratory in Beltsville, Maryland for PCR confirmation.

The MDA also participated in the 2006 *P. ramorum* National Survey by: 1) Inspecting all trace back nurseries that were identified in 2005 but not found positive for *P. ramorum*; 2) Inspecting 10 trace forward nurseries that received plants from known infected suppliers and were not found positive for *P. ramorum*; and, 3) Inspecting 20 additional nurseries based on the criteria described in the A total of 508 plants at 33 production nurseries were sampled. DNA from 99 of these samples was extracted and analyzed at the National Plant Germplasm and Biotechnology Laboratory in Beltsville, Maryland using PCR techniques. No positives were detected. Ten trace forward nurseries were inspected and found negative for *P. ramorum*. Forty trace back nurseries from 2005 were inspected as part of normal annual nursery grower and dealer inspections.

Since 2004, the MDA has collected 2,951 samples at more than 90 nursery growers and dealers. No *Phytophthora ramorum* has been detected in the state to date.



## Gypsy Moth

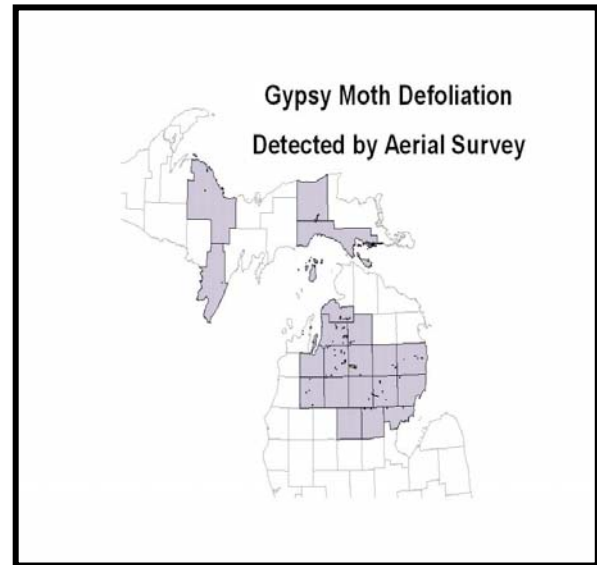
Gypsy moth populations were down significantly in Michigan in 2006, with 31,545 acres defoliated compared with 148,525 in 2005. Cool, wet spring weather favorable to development of the fungal pathogen *Entomophoga maimaiga* likely contributed



to the decline. Increased soil moisture also helped reduce stress on defoliated trees. As part of the Michigan Cooperative Gypsy Moth Suppression Program, 15,981 acres were treated in six counties in the Lower Peninsula. Foray 48F was applied to 15,699 acres; Gypchek was used on 282 acres.



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Due to declining populations and reduced federal funding, there will be no cooperative gypsy moth treatments conducted in 2007.



### Invasive Plant Forest Health Report

Three MDNR training sessions on **Woodland Invasive Plant Species** were offered in 2006. A Michigan Natural Features Inventory Plant Ecologist, Phyllis Higman, was contracted by the Wildlife Division to organize and present the workshops. Topics included when and why invaders are a problem, the impacts of invaders on forests and wildlife, identification of species of concern, and control methods. The workshops were also used to introduce a new **Invasive Plant Forest Health Report**. MDNR personnel will use this report to record invasive species occurrences on state forest lands.

The **Michigan Invasive Plant Council (MIPC)** strives to increase awareness, education and management of invasive plants. Invasive plants threaten all of Michigan's ecosystems. MIPC's **Michigan Plant Invasiveness Assessment System** is tailored to Michigan's environmental conditions and the diversity of its natural, managed, and built landscapes. The objective is to identify relevant biological, ecological, economic information to aid in evaluating the impact on our Michigan ecosystems. These assessments are complete, they provide the foundation of an Michigan Invasive Plant Council recommended plan Efforts to remove and keep **Garlic Mustard** (*Alliaria petiolata*) from establishing in Upper Michigan continue. A seventy acre northern hardwoods site in the Eastern Upper Peninsula has a seven year prescribed burn plan which includes follow-up use of glyphosate herbicide to remove plants missed by fire. Michigan Technological University, School of is monitoring treatment efficacy and plant community response to burning and herbicide treatments.



The management, and plants may have ongoing. When accompanying of action.

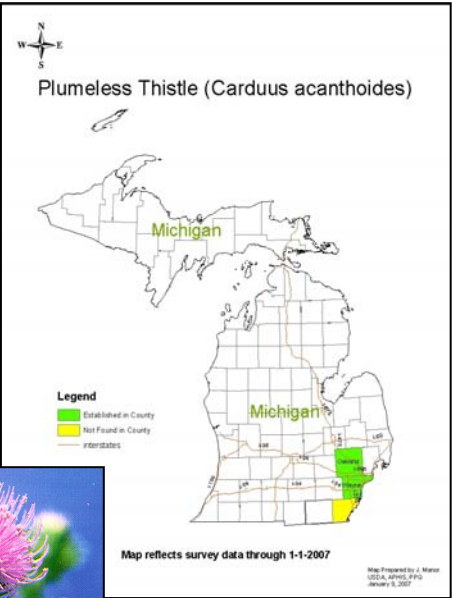
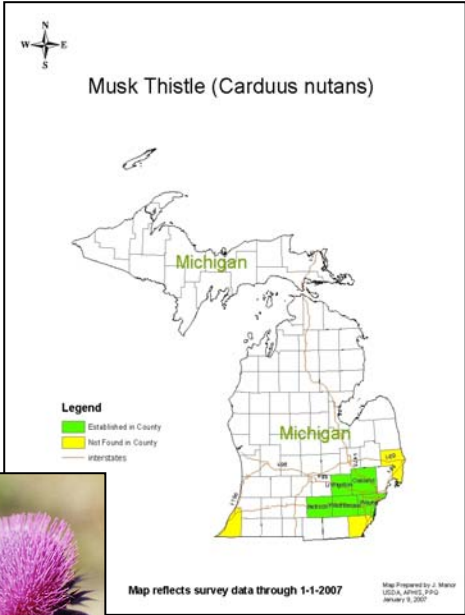
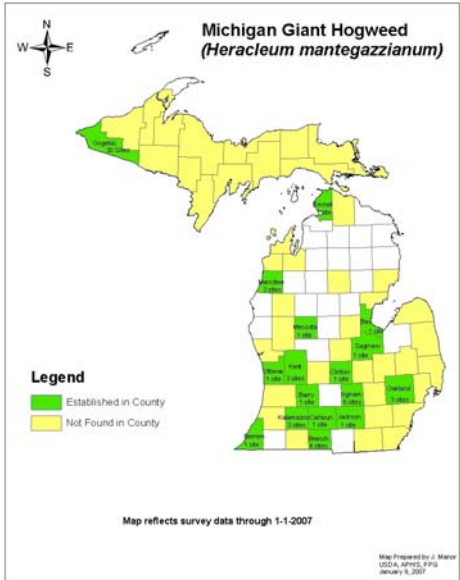


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The Michigan Department of Agriculture detected **Giant Hogweed** (*Heracleum mantegazzianum*) in Barry County in 2006. This brings the total to 17 confirmed counties (See map).

The USDA Animal and Plant Health Inspection Service (APHIS) detected two new Michigan Prohibited Weeds in 2005. AHPIS found both **Musk Thistle** (*Carduus nutans*) and **Plumeless Thistle** (*Carduus acanthoides*) in SE Michigan. They continued to record new counties in 2006 (See Maps). Both infestations are believed to be outliers.



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## Oak Wilt

A 5-year EA was approved in the fall, 2006 allowing USDA Forest Service Suppression monies to be spent on the Upper Peninsula Oak Wilt Suppression Project in Menominee & Dickinson Counties (See map). A vibratory plow was used to establish 40,041 feet of root graft barriers on 53 sites representing about 234 acres of oak wilt epicenters. State owned forest comprised sixty five percent of this area. Red oak within the epicenters will be removed before the spring, 2007 to prevent pressure pad development which can lead to overland spread of the disease.



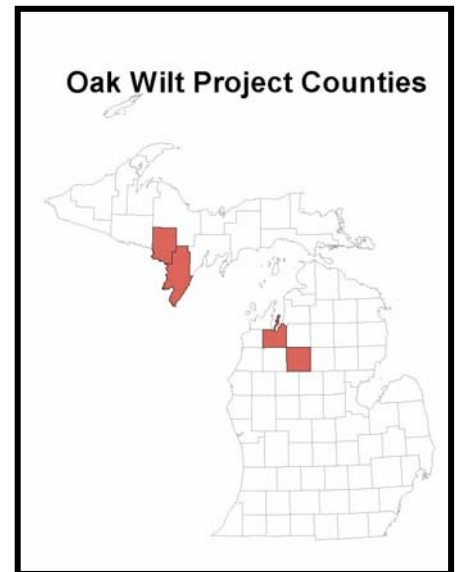
Landowner and public education to prevention the re-introduction of oak wilt via firewood movement and spring tree injury was achieved via newspaper articles, training sessions, site visits generated via detection efforts and public inquiries, and distribution of educational materials. The project goal is to remove oak wilt from the Upper Peninsula. An important component of this effort is a continued education and outreach effort to prevent overland spread via tree injury from April 15 to July 15, and to stop the reintroduction of oak wilt into the UP via infected firewood.

## Oak Wilt - Northern Lower Peninsula

With a large oak forest component in the region and a significant forest recreation industry, Michigan's Lower Peninsula forest resource is at significant risk of oak wilt establishment and spread each year. In recent years, as oak wilt continues to spread across the landscape, the MDNR Forest Health Monitoring Program has focused on early detection of and rapid response to oak wilt infections in high-use recreation areas on state land, including state parks and state forest campgrounds.

This year, oak wilt infections were treated in two state forest campgrounds in Grand Traverse and Missaukee Counties. Over 3550 feet of root graft barrier lines were installed in October in several campgrounds with the disease. A vibratory plow with a 6-foot blade was used to create the barriers, which were marked in late summer to allow complete expression of current-year symptoms. Symptomatic trees within the barrier will be cut and burned on-site this winter, and remaining trees will be monitored for the next 3 growing seasons and destroyed if they become infected.

An alternative method of treatment being tested on the Chequamegon-Nicolet National Forest near Lakewood, Wisconsin is being evaluated for possible testing in Michigan in 2007. The method involves breaking root grafts by physically removing stumps with a large backhoe in place of a vibratory plow. Tentative findings indicate the method is cost-effective and can slow or stop the progression of oak wilt below ground for at least 3 years.



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## Technology Update - Digital Aerial Sketchmapping System (DASM)

In cooperation with U.S. Forest Service State & Private Forestry, Northeastern Area and the U.S. Forest Service Forest Health Technology Enterprise Team, a pen GPS-linked DASM system was used to conduct the 2006 statewide health survey. Over 102,000 acres of forestland were flown and with the system, using color-infrared LANDSAT satellite imagery sharpened to 15m resolution.



tablet-based,  
aerial forest  
evaluated  
pan-

Advantages of DASM over traditional 'pen-and-paper' sketchmapping include:

- Because data is recorded on a variety of high-resolution, highly detailed digital backgrounds and is stored real-time as it is collected, spatial precision and accuracy is improved dramatically.
- Data can be backed up quickly for improved data integrity and security.
- Background maps displayed during sketchmapping can be customized to meet the needs of individual surveys.
- Groundtruthing spatial precision is improved by using the DASM in a vehicle or on foot to locate ground points or polygons.



## Heavy Seed Crops

Many conifers and hardwoods produced **Heavy Seed Crops** in 2006. Spruce, cedar, larch, American beech, red maple and sugar maple produced less dense, off-color tree crowns. Trees with heavy seed crops produced much less foliage and canopies assumed the color of the seed. Aerial surveys for defoliators like the spruce budworm, larch casebearer and hardwood defoliators like linden looper and fall cankerworm were problematic. For example, spruce trees throughout the state had dark brown crowns which mimicked heavy spruce



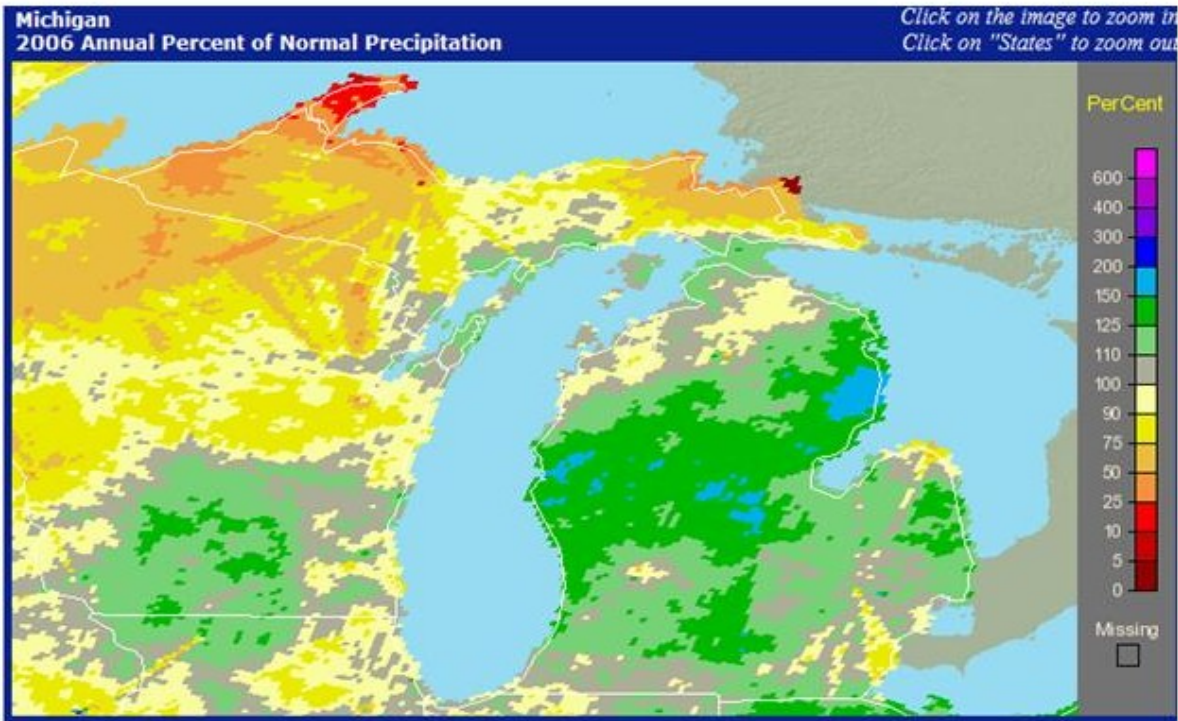
budworm defoliation. This had the effect of masking any actual budworm defoliation. Seed crops also masked and contributed to the hardwood discoloration and defoliation in sugar maple resulting from a combination of a late spring frost, drought and off-site conditions such as shallow and light soils. For these reasons, there was a greater need for ground evaluations of aerial surveys in 2006.



Prepared by Forest, Mineral & Fire Management Division

## 2006 Precipitation Summary

Moisture-wise, the season got off to a good start over nearly all of Michigan thanks to several rounds of heavy snow and rain during January and February and near complete off-season soil moisture recharge. Seasonal growing degree-day accumulations were generally running 5 to 10 days ahead of normal across the state by early May. Following the rapid start of the season, an upper air troughing pattern developed over the Great Lakes region during the second week of May and persisted for almost two weeks, resulting in an extended period of cool and wet weather. Rain fell over much of Michigan on an almost daily basis, with 2-5 inch totals reported over many central and southern sections of the state. Precipitation departures ranged from more than 6 inches above normal in west central and central sections of Lower Michigan to more than 6 inches below normal in western sections of Upper Michigan.



Unusually hot and humid weather impacted Michigan and nearly all of the continental United States during the last two weeks of July and the first week of August.

Overall for the 5-month May-September period, precipitation totals ranged from much below normal levels in many part of Upper Michigan (the second consecutive year that this has occurred) to much above normal levels in central and southern sections of the Lower Peninsula.

*Information courtesy of Dr. Jeff Andresen, State Climatologist, Michigan State University Dept. of Geography*



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## Miscellaneous Pests 2006

The **Spruce Budworm** (*Choristoneura fumiferana*) defoliated 28,985.11 acres in the Upper Peninsula. Areas of light budworm defoliation have been visible for the last few years. The 2006 survey was complicated by a very heavy spruce cone crop. Cones thinned crowns and turned upper canopies brown making aerial detection of light to moderate defoliation improbable.

The **Jack Pine Budworm** (*Choristoneura pinus pinus*) defoliated 150645.22 acres in 2006. The budworm is the most significant pest of jack pine in North America. Stands older than 50 years are most vulnerable to damage. Jack pine over 50 years old that has suffered 2 or more defoliations during the past 3 years is at highest risk of top kill or mortality. Damage surveys helped evaluate tree mortality and project future budworm induced volume losses. Heavily damaged stands are being prepared for 2007 harvest. Regenerated stands will then have 50 years before they again become vulnerable to the 8-12 year cycles of budworm epidemics. Harvesting stands when they reach maturity minimizes budworm-caused tree mortality. The long-term goal is to bring the jack pine resource selected to meet forest product demands into a 50-60 year rotation; thus, greatly reducing budworm impacts.

The **Hemlock Looper** (*Lambdina fiscellaria*) larvae can be extremely destructive to hemlock, balsam fir, and white spruce. Hemlocks may die after one year of severe defoliation, fir in one or two years. Loopers have been epidemic in isolated areas of the state in the last few years. This has resulted in thin crowns, top kill and tree mortality. The eastern UP in Luce and east Alger Counties have been especially hard hit. Populations moved to areas of Northern Lower Michigan and the central UP in 2006.



Because loopers first feed on lower branches, it is difficult to detect feeding damage with aerial surveys until trees are heavily damaged.

A serious Maple Decline is occurring in sugar maple stands growing on rocky knolls in northwest Marquette and northeast Baraga counties in the UP. Several factors are contributing to significant crown thinning, top kill and some tree mortality. Factors include: 1) shallow soils over bedrock; 2) lighter soils; 3) a series of droughts in the past two decades; 4) south and west exposures on steep slopes which contribute to drought stress; 5) defoliation by late spring frosts and linden loopers in 2006; and 6) possibly logging practices which damage root systems on these shallow soils and dry soils if canopies are opened too much during stress events. This decline was mapped during 2006 aerial surveys and will be evaluated in 2007.



The **Red-Headed Pine Sawfly** (*Neodiprion lecontei*) is an important defoliator of ornamental, natural-growing, and plantation pines. Heaviest infestations are commonly on pines growing under stress, particularly those at the edges of hardwood forests, on poor soils, and where there is heavy competitive vegetation. The sawfly primarily infests trees less than 15 feet tall. Heavily defoliation results in top kill and tree mortality. Moderate to heavy defoliation



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stunts height growth and forking of the main stem often results. Sawfly populations have been active in the eastern Upper Peninsula and the northern Lower Peninsula beginning in 2002. Dimlin 4L was aerially applied to 636 acres of infested plantation red pine in 2006.

**Maple Tar Spot** was again a common site on Norway maple leaves in 2006. Other maples are also infected. Fungi in the genus *Rhytisma* infect the leaves of maples causing the characteristic black spots to form on upper leaf surfaces. Heavy infections can cause early leaf drop in the fall. Black spots grow in diameter and thickness until late summer.



**Phyllosticta Leaf Spot**, also known as purple eye, might be confused with maple tar spot. This leaf spot is caused by the fungus *Phyllosticta minima*. On maple, leaf spots appear with pale yellow centers and purple borders. The spots are irregularly round and ¼ inch in diameter. Severe infection can result in partial defoliation of the tree. Often the disease goes unnoticed until fallen leaves accumulate under the tree. The fungus survives the winter in fallen leaves. In the spring spores are produced and dispersed to the new leaves. Thus, removing leaves after leaf fall helps reduce spring infections.

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