

The Southern Perspective

Providing Leadership for the South's Forests

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NATIVE VS. EXOTIC FOREST PESTS: SOME VERY IMPORTANT DIFFERENCES – AND WHY WE SHOULD BE CONCERNED

Dr. E. L. Barnard, forest pathologist and supervisor, Forest Health Section, Florida Division of Forestry, FDACS

If you are a southern forest landowner growing pines for pleasure or profit, you've likely heard of (and perhaps had experience with) fusiform rust, pitch canker, annosum root disease, and/or pine bark beetles (southern pine beetles, Ips engravers, black turpentine beetles). Indeed, these diseases and insects have been the "poster children" of biological threats to southern pine forestry for decades, and for reasons that are understandable. They are common throughout the South, they are recognizable, and many landowners have suffered significant economic loss as a result of their activity.

Interestingly, all of these diseases and insects have something in common. All are native (endemic to the southern U.S.)



Old world climbing fern, a non-native (exotic) pest plant, growing on and among baldcypress in south Florida.

and all, in one way or another, respond to predisposing forest conditions. None has the capability to annihilate its host pine species or permanently alter the forest ecosystem of which it is part. Contrast these realities with the history and potential represented by non-native (exotic) forest pests (pathogens, insects, and invasive pest plants).

Exotic pests are now the "headliners" in the world of forest health, and for good reason. Chestnut blight, caused by an exotic fungus introduced into North America early in the 20th century, has effectively eliminated American chestnut (the once dominant hardwood in the Appalachian Mountains) from its entire native range – within a few decades. Dutch elm disease, the product of an exotic fungus and two bark beetles (one native, one exotic) has decimated populations of American elms in forests, on city streets and on college campuses, with losses estimated in billions of dollars – within a single human generation.

Today, exotic forest pests (pathogens, insects and invasive pest plants) continue their legacy. Dogwood anthracnose, putatively a function of an exotic fungal pathogen, has wreaked havoc in the eastern U.S., eliminating flowering dogwood from many forest habitats. Butternut canker, caused by another suspected exotic pathogen, has killed 90 percent of butternut trees in certain parts of North America and apparently close to 80 percent of

Photo courtesy of Peggy Greb, USDA Agricultural Research Service

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**SOUTHERN GROUP
OF STATE FORESTERS**

The Southern Group of State Foresters is comprised of the state forestry directors from the 13 Southern states, U.S. Virgin Islands, and the Commonwealth of Puerto Rico as well as leadership from the USDA Forest Service Southern Region, the Southern Research Station, and the International Institute of Tropical Forestry. Collectively, they provide leadership for the South's forests.

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John C. Burwell,
*Chairman, Southern
Group of State Foresters
and Oklahoma State
Forester*

MESSAGE FROM THE CHAIRMAN

Healthy forests provide innumerable public benefits, including clean air, clean water, recreational opportunities, abundant wildlife, and forest products that we use every day. Traditionally, maintaining forest health has been seen as protecting the forests from insects, diseases, destruction from wildfires and invasive species. While these things are obviously critical to forest health, foresters must also consider important the protection of forests as working ecosystems, supporting all of the social, biological and ecological components dependent on America's forest lands. The diversity of our nation's forests is tremendous, and so our programs lend themselves to that diversity.

State forestry agencies are in a unique position to impact the future management of America's temperate forest. Our clients are the largest segment of forest landowners in America. As state agencies working through local offices, we can best design and implement programs that fit land ownerships at an eco-region level, thereby having an overall positive outcome on the forest in its entirety. In this way, America's state forestry agency will play a key role, if not the most important role, in assuring healthy forests for the next generation of Americans.

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this species in the Southeast.

More than 20 million ash trees have been destroyed by the emerald ash borer, another Asian insect, in Michigan, Ohio and Indiana since its initial detection in Detroit in 2002. The hemlock woolly adelgid, again from Asia, has invaded nearly half of the eastern range of eastern hemlock from Georgia to Maine; it is expected to completely eliminate eastern hemlock in time. And, since its initial detection in Savannah, Ga., in 2002, an Asian ambrosia beetle has been vectoring a previously undescribed

vascular wilt fungus that is killing redbays and sassafras trees at alarming rates along the Atlantic coastal plain from Charleston, SC, to Indian River Co., Fla. Loss of redbay as a forest tree species is now considered a distinct possibility.

These are just some of the more noteworthy or

damaging exotic pathogens and insects that have impacted or are impacting our native forests. We could easily add any number of non-native (exotic) invasive pest plants (kudzu, melaleuca, cogongrass and old world climbing fern) that are displacing native species, changing fire conditions and threatening natural ecosystems. Collectively these foreign invaders have altered the forests that we have known and loved.

The USDA Forest Service and others are now advocating and initiating efforts to collect seed of trees threatened by exotic insects and pathogens for re-establishment of the species after foreign invaders have killed off the current native populations and then died off themselves for lack of host material. The seriousness of the threats represented by invasive pest species resulted in a Presidential Order (#13112) in 1999, establishing a national Invasive Species Council and the development of a federal Invasive Species Plan. Effective measures, including public awareness and responsible action (particularly effective regulation of imported goods and associated packing materials) to prevent new introductions and minimize the impacts of exotics are essential.



Dead and dying American elms along a country road in New England; decimated by Dutch Elm Disease, a complex involving a non-native (exotic) fungal pathogen and at least one exotic bark beetle.

NEW DISEASE EPIDEMIC THREATENS REDBAY AND OTHER RELATED SPECIES

James Johnson, Georgia Forestry Commission

Laurie Reid, South Carolina Forestry Commission

Bud Mayfield, Florida Department of Agriculture and Consumer Services – Division of Forestry

Don Duerr, USDA Forest Service – Forest Health Protection

Stephen Fraedrich, USDA Forest Service – Southern Research Station

Laurel wilt, a new disease of redbay (*Persea borbonia*) and other plant species in the family Lauraceae, is causing widespread mortality in the coastal regions of South Carolina, Georgia and Florida. The disease is caused by a fungus (*Raffaelea* species) that is introduced into trees by an exotic insect, the redbay ambrosia beetle (*Xyleborus glabratus*), which is native to Asia and is the 12th new species of ambrosia beetle introduced into the U.S. since 1990.

Redbay trees grow in the Coastal Plain region from eastern Texas to Virginia and are ecologically and culturally important, although of minor commercial timber value. Redbay trees provide fruit for song birds, turkey, and quail; deer and black bear browse on the foliage and fruits. Additionally, the larvae of the Palamedes swallowtail butterfly require redbay leaves for development.

The redbay ambrosia beetle was discovered in Savannah's Port Wentworth area in spring 2002; however, it is likely to have been established in the area prior to 2002 when the three adult specimens were trapped at the port. The beetle likely entered the country in solid wood packing material with cargo that was imported at Port Wentworth. Redbay trees began dying in Georgia and South Carolina in 2003. By early 2005, officials with the Georgia Forestry Commission (GFC), South Carolina Forestry Commission (SCFC), and USDA Forest Service began to suspect the newly discovered ambrosia beetle was associated with this mortality. Subsequent research has found that the mortality is caused by a pathogenic fungus that is carried by the beetle. The fungus is believed to be transmitted to healthy redbay trees when they are attacked by the beetle, resulting in a wilt disease. The disease has also been discovered in individual plants of the federally endangered pondberry (*Lindera melissifolia*), the threatened pondspice (*Litsea aestivalis*), sassafras (*Sassafras albidum*) and avocado (*Persea americana*).



Abrosia galleries



"Toothpicks" can be found on trees under attack.



Dead redbays

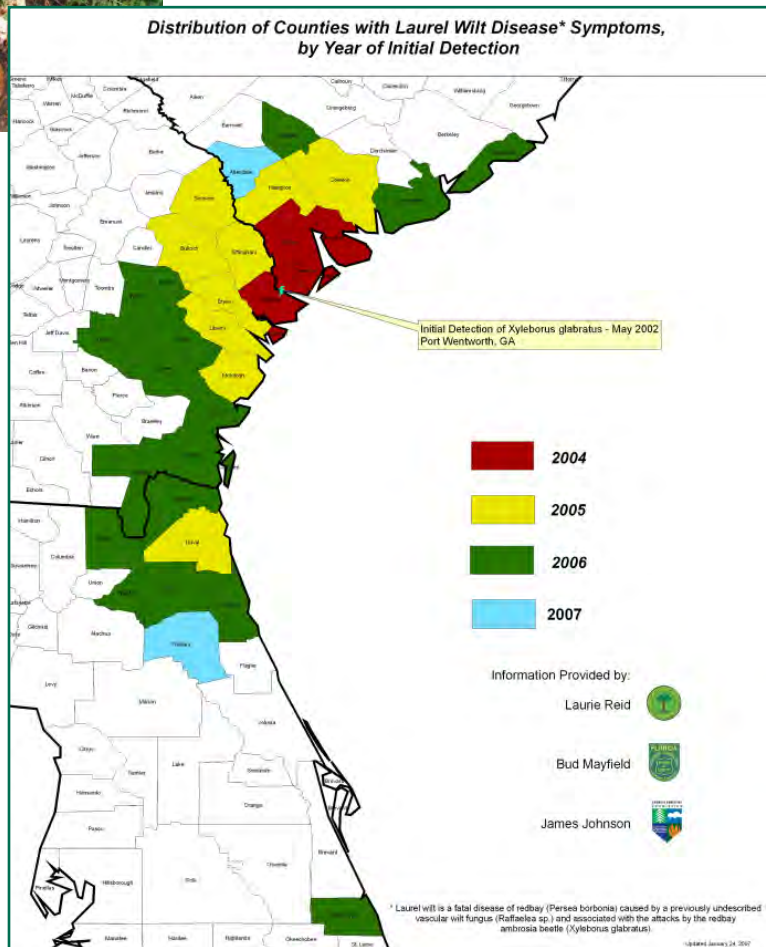
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Ambrosia damage

Many native ambrosia beetles (40 plus species) occur in the United States and primarily target stressed or dying trees. In general, ambrosia beetles carry specific fungi that are introduced into the trees as they tunnel into the wood, and are fed upon by the developing insects. In the case of the redbay ambrosia beetle, one of the associated fungi also acts a pathogen as it spreads through the tree's vascular system, causing the tree to wilt and die. This associated fungus is in the same class of fungi as those that cause Dutch elm disease and blue stain in pines.

All of Georgia's coastal counties now have confirmed laurel wilt and the disease is moving northward in South Carolina, southward in Florida, and inland at an alarming rate. In 2004, those states reported three counties with damage; now the disease has spread to 31 total counties. Officials estimate that natural spread is about 20 miles per year, but movement of infested firewood, wood chips and logs may be a major factor in spreading the disease into new locations not contiguous with main area of infestation.



There are no proven management strategies for preventing the development of laurel wilt disease. Early sanitation of newly infested trees and limiting movement of infested wood may help slow the spread. Field trials evaluating the effectiveness of certain pesticides are being conducted in Florida and Georgia. Formal ground surveys are being conducted by the SCFC and the GFC to develop baseline infestation information. Research is ongoing with the USDA Forest Service – Southern Research Station (Athens, GA and Pineville, LA), Louisiana State University, Iowa State University, University of Florida, and Florida DACS-DOF. Substantial information about this problem will soon be available at: <http://www.fs.fed.us/r8/foresthealth/>.

NATIONAL INSECT AND DISEASE RISK MAP

Jim Brown, forest health monitoring coordinator, Forest Health Protection, Atlanta, Ga.

The second periodic National Insect and Disease Risk Map (NIDRM) was completed in 2006. The NIDRM is a strategic assessment of the risk of tree mortality due to major insects and diseases. It is more than “just a map,” being compiled from nearly 190 separate models in a GIS-based framework that assigns risk to individual, one-kilometer pixels based on forest type, host species basal area, and numerous other factors associated with different host species and damage agents.

In the composite map, a pixel is colored red if the models project that 25 percent or more of the standing live volume of trees greater than 1 inch in diameter in that pixel will die over the next 15 years.

As a strategic product, the NIDRM is not intended to predict mortality events, but rather to project potential risk. It provides Congress, USDA officials, and federal and state land managers with a tool to illustrate where mortality risk is greatest and, by inference, where prevention and suppression efforts may be most beneficial and effective. It is quite flexible and can be readily customized to meet regional or local needs for assessment of specific pest problems. The multi-criteria models on which it is based can be modified to reflect changing conditions and new data; new models may also be added to address newly-identified problems, such as those caused by introduced exotic pests.

The 2006 map projects mortality risk for 13.25 million of the South’s forested acres. The most significant risk agent being the southern pine beetle with 8.4 million acres.

A portal for accessing the NIDRM has been prepared by the Forest Health Technology Enterprise Team (FHTET) at Ft. Collins, Co. It is still under development, but will have a variety of new tools and attributes added in coming months. It can be accessed at:

<http://www.fs.fed.us/foresthealth/technology/nidrm.shtml>

SUDDEN OAK DEATH EARLY DETECTION SURVEYS FOR FORESTS IN THE SOUTH

Steve Oak, forest pathologist, USDA Forest Service, Southern Region FHP, Asheville, NC

In 1995, a pathogen, *Phytophthora ramorum*, that causes what is known as Sudden Oak Death was first detected in central coastal California. Today, it has killed more than a million native oak and tanoak trees in California and Oregon. The pathogen also infects the leaves and twigs of common ornamental nursery plants, such as rhododendrons and camellias, which serve as vectors for pathogen dispersal. The vulnerability of other ecosystems is suggested by greenhouse inoculation trials and the discovery in Europe of this disease in hosts that are also abundant in oak-dominated forests of eastern North America. The risk of introduction in the east is increased by active trade in susceptible woody ornamental hosts.

In 2003, recognizing the risk of this pathogen becoming established in the oak-dominated forests outside of the regulated areas, federal and state forestry agencies in seven eastern states initiated surveys for early detection of this pest. A risk map based on climate, host range and abundance, and possible routes of introduction was used to direct sampling location and intensity. Surveys were implemented in 36 states during 2004 following the accidental introduction of the pathogen to nurseries and landscapes outside the regulated areas. To date, the 13 states in the Southern Region have sampled 1,473 sites generating 6,008 samples for laboratory diagnosis.

Improving knowledge of Sudden Oak Death is reflected by the 21 modifications to the USDA-APHIS regulations that have occurred in the last five years. Of greater importance than the regulatory landscape, however, sudden oak death occurrence in North American forests is still confined to central-coastal California and southwestern Oregon. Despite this regulatory vigilance, however,

accidental introductions to nurseries and landscape plantings via infected ornamental plants continue to occur.

While evidence from our surveys strongly suggest that the pathogen is not yet established in forests outside the regulated areas, periodic detections in other areas underscore the need for continued early detection surveys for *P. ramorum* in U.S. forests.

A COMPARISON OF USDA AND NASF FARM BILL PROPOSALS

Mike Countess, Southern Group of State Foresters' Policy Analyst

Early this year, the National Association of State Foresters (NASF) and the USDA completed recommendations for forestry components in the 2007 Farm Bill.

For the most part, the recommendations of the USDA and NASF are similar or complementary. Both proposals recommend programs and policies that address commonly shared concerns about the loss and fragmentation of forest land; the need to improve efficiency and accessibility of programs to private landowners; improved response and recovery from disasters; innovative approaches to improving markets, including opportunities for carbon sequestration and other "environmental services," and efforts to expand and expedite utilization of woody biomass as a sustainable source of renewable energy.

Both USDA and NASF propose a very similar program to more efficiently address critical forest resource areas and develop priorities for collaborative efforts between the public and private sector to deliver programs and services. They recommend a process to develop a Statewide Forest Resource Assessment and Plan that would enhance coordination and leverage funding to focus on areas of need.

Both recognize the need to provide technical assistance and support services to local governments relative to land-use planning and growth-management strategies. NASF recommendations focus on grants to develop improved analytical and decision-making capabilities, while the USDA proposal includes an additional component for acquisition of critical lands within targeted communities.

USDA proposes to improve access and delivery of cost-share services by combining certain programs, such as Environmental Quality Incentives Program (EQIP), Wildlife Habitat Assistance Program, and Forest Land Enhancement Program. The proposal does not specify how the forestry components would be structured and implemented. NASF recommends specific adjustments in EQIP to assure that forest land and forest management

practices qualify and are competitive for program benefits.

USDA proposes to expand enrollment in the Conservation Security Program (CSP) but does not provide for forestry participation beyond current program provisions. NASF recommends specific adjustments in CSP to assure that forest land and forest practices are eligible for consideration in CSP.

Both recommend approaches for improving market opportunities for forest resources services and products. USDA focuses more on innovations within the market place for "environmental services," whereas NASF is more comprehensive and includes technical assistance and grants for conventional markets as well as environmental or forest ecosystem services.

The most significant disparity between the two proposals is in recommendations for disaster recovery. USDA proposes to consolidate the Emergency Watershed Protection (EWP) and the Emergency Conservation Program (ECP) to provide a one-stop source for landowners. NASF recommends development of a new program to provide disaster recovery and relief for all impacted private forest lands as declared by the Secretary of Agriculture or the President. Also, NASF proposes a broad concept of disasters including large-scale losses from invasives.

Finally, both USDA and NASF recommend expanded programs and services to improve utilization of biomass for renewable energy. While the proposals emphasize grants and subsidies to accelerate the development of cellulosic ethanol technologies, USDA specifies the reauthorization and continuation of certain loan programs and expanded research. It also proposes an enhanced Conservation Reserve Program that emphasizes biomass production for energy, whereas NASF advocates a separate contract payment program for promoting the sustainable production of dedicated native perennial energy crops including trees with guidelines to assure protection of soil, air, water and wildlife.

For more information on Legislative Happenings, contact:

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SOUTHERN PINE BEETLE PREDICTION SYSTEM PROVES EFFECTIVE IN 15 STATES

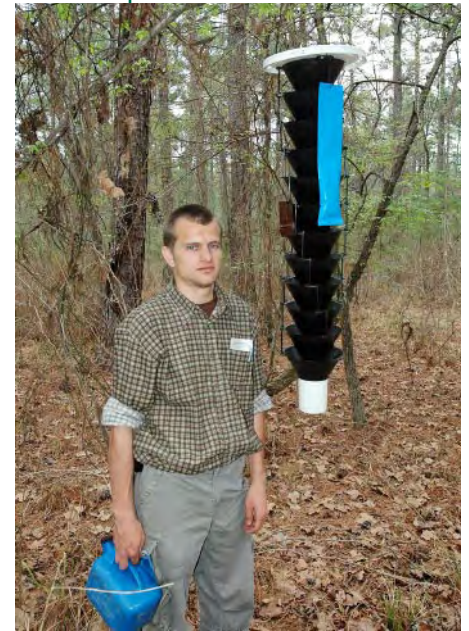
Ronald F. Billings and William W. Upton,
Texas Forest Service

Dogwoods are blooming and spring has sprung in most Gulf Coastal states by now. This exciting time of year also is the preferred season to predict whether the southern pine beetle (SPB), the most destructive pest of southern pine forests, is likely to be a problem in your county or state.

An operational system to forecast infestation trends (increasing, static, declining) and relative population levels (high, moderate, low) of SPB, *Dendroctonus frontalis*, has been implemented throughout the range of this forest pest in the southern and eastern United States. The Texas Forest Service (TFS) developed the system with input from federal and state cooperators across the South. The system involves monitoring numbers of SPB and those of a major predator (the clerid beetle, *Thanasimus dubius*) using pheromone traps (see figure).

In general, from one to three multiple-funnel traps baited with the SPB aggregation pheromone frontalin and pine turpentine are placed in each county or National Forest Ranger District to be surveyed. Federal and state forest pest specialists in 15 states have participated annually in the region-wide prediction system, most for two decades. The traps are monitored for four consecutive weeks during the spring, beginning when dogwoods bloom. This seasonal event coincides with the long-range dispersal of SPB.

Responding insects are collected weekly. Trap catch data is sent to the Texas Forest Service for compiling and for making local, state and regional predictions of SPB trends. The average number of SPB/trap/day and the ratio of SPB to clerids in the current and previous year for the same trapping location are the variables used for predicting infestation trends and population levels for the remainder of the year.



Example of a multiple-funnel pheromone trap used to monitor SPB populations and forecast infestation trends.

OAK DECLINE AND RED OAK BORER: GONE, BUT NOT LONG GONE?

Dale A. Starkey, USDA Forest Service, Southern Region, State and Private Forestry, Forest Health Protection, Pineville, La.

In 1999, thousands of red oaks began to die rather suddenly in the Ozark Mountains of Arkansas, Missouri and Oklahoma. A major oak decline event was underway that would continue for several years and was accompanied by an unprecedented outbreak of red oak borer, an insect that bores into the sapwood and wood of red oak trees. Thousands of acres of oak forest were affected with some areas experiencing almost 100 percent mortality of red oaks; and, where red oaks dominated the overstory of stands, the main forest canopy just disappeared.

Oak decline is a complex syndrome that affects mostly red oaks in mature forests. It is usually initiated by several years of drought or defoliation by an insect, such as the gypsy moth. Then, stressed trees are further attacked by secondary pests, such as Armillaria root disease; 2-lined chestnut borer; red oak borer, and Hypoxylon canker.

The stage was set for this event with the development of hundreds of thousands of acres of mostly mature oak forest that had been little managed and rarely regenerated for decades.

Decline and mortality continued into the mid-2000s, but has tapered off with the return of better moisture conditions. And, the red oak borer population has collapsed to more normal levels. Oak decline episodes recur from time-to-time and the conditions that set the stage for this event, in spite of the widespread mortality, have not disappeared.

PARTNERSHIPS AND COOPERATION COMBAT OAK WILT IN TEXAS

Ronald F. Billings,
Texas Forest Service

Central Texas, well known for its scenic hill country, wildflowers, crystal-clear rivers, and large cattle ranches, is facing myriad challenges. Where bison once roamed, retirees and others are seeking home sites with elbow space, creating problems with fragmentation of large ranches, increasing demands for water, and increasing the threats of wildfires. Furthermore, live oaks, prized in this arid part of Texas for their stately beauty and welcomed shade, are being threatened by a destructive disease – oak wilt. For the past 25 years or so, the Texas Forest Service (TFS), the USDA Forest Service, Forest Health Protection (USFS/FHP) and others have been managing the oak wilt problem through a program of partnerships and local cooperation.

stopped, infection centers may spread 75 to 100 feet per year, killing or drastically affecting every live oak in their path. Losses are both aesthetic and economic, particularly to urban residents. In cities, such as Austin and San Antonio, the live oak trees may represent 20 percent of a property's value.

Treatments, consisting of trenching to a depth of four feet at a distance of 100 feet in front and completely encircling expanding centers, have been successful in halting oak wilt spread in two out of every three cases. Re-infections or breakouts are often the target of a second treatment.

Digging a four-foot trench in Central Texas is a costly and arduous task, since the trees typically grow on top of nearly solid limestone. Massive rock saws or backhoes are often required.

To date, the suppression project has installed more than 3.36 million feet (637 miles) of trenches to control 2,400 oak wilt centers. This is equivalent to a single trench extending from Dallas to Birmingham, Ala. A Web page devoted to oak wilt management in Texas (<http://www.texasoakwilt.org>) offers additional information.



Oak wilt killed this valuable live oak in Austin, Tx.



A rock saw capable of cutting a 60-inch trench through limestone is a common machine used for oak wilt trenching in Central Texas.

Oak wilt is caused by a native fungus, *Ceratocystis fagacearum*, a vascular pathogen that kills susceptible trees by blocking the water conducting system.

New infections of oak wilt occur when spore-

bearing insects carry the fungus from infected red oaks to fresh wounds on live oaks. Once a live oak becomes infected with oak wilt, the fungus may spread rapidly from tree to neighboring tree, aided by the interconnected root system that characterizes the live oak stands or "motts." If not

Oak Decline and Red Oak Borer, continued from page 7

What can forest landowners and managers do? At the stand level, avoid allowing stands with high components of red oak to become dense and overmature with heavy understories of shade-tolerant species. We know that red oaks suffer the most rapid and widespread mortality in decline events, and we also know that older stands are more susceptible to severe damage. Mid-rotation stand treatments that favor a mixed-oak stand, development of advanced oak reproduction, and control stand density would be desirable and might lessen the effects of a decline episode were one to occur. On a landscape level, ensuring a more even distribution of age classes across the landscape may give some protection during future events.

THE BATTLE TO SAVE OUR HEMLOCKS

Rusty Rhea, USDA Forest Service, Forest Health Protection

The tiny hemlock woolly adelgid (HWA) continues to march into the hemlock forests across eastern North America. With half the range of the eastern hemlock and all the range of Carolina hemlock already infested, one thing is certain—unless we intervene in significant ways, all our native hemlocks will be lost. Fortunately, due to partnerships across multiple states, we've been able to creatively look at ways to try to control this pervasive threat.

As is often the story, HWA is an exotic pest that originates from Asia. It was accidentally introduced into the eastern US in the 1950s near Richmond, Va., possibly due to the importation of Asian hemlocks for ornamental use. The distribution of the HWA remained localized until the 1970s when the adelgid range expanded rapidly into the Shenandoah Mountains, Blue Ridge Mountains, and finally into Southern Appalachia. The adelgid is spread predominantly by wind, birds or mammals.

Virginia, Kentucky, North Carolina, Tennessee, South Carolina and Georgia have well-established adelgid populations with varying levels of impact and mortality. Virginia has by far the most serious impacts but other states are not far behind. The lack of significant winter mortality of the adelgid, seemingly ideal growing conditions in the southeast, and absence of either natural enemies or resistance allow for rapid expansion of adelgid populations and have expedited impacts to millions of southern hemlocks.

In the east, the adelgid impacts to both host species are severe. Once the tree is infested, mortality typically occurs in less than five years compared to the seven to 12 years typical of hemlocks growing in the northeastern US. The adelgid threatens not only the hemlock resource but also the unique ecosystem it helps comprise. Eastern hemlock is considered to be an ecologically important tree species and in many cases, irreplaceable.

A number of wildlife species (including birds, fish, invertebrates, amphibians, reptiles and mammals) benefit from the special environment hemlock stands support. Although most wildlife species are not completely limited to hemlock for their habitat requirements, many wildlife species will select hemlock trees and forests for food, shelter or breeding purposes. The dense shade created by hemlocks also maintains cooler stream temperatures, allowing some aquatic species to exist there that would not otherwise.

Biological control is the most promising prospect to date, with an objective of the establishment of a complex of natural enemies of HWA on eastern and Carolina hemlocks to reduce HWA populations to non-injurious levels while ensuring a minimal risk to non-targets.

The southern states with hemlock populations are actively developing state management plans for HWA. Plans are based on an integrated approach implementing both chemical and biological controls, depending on the site and management objectives. Labs located at the University of Tennessee, University of Georgia and at Clemson University, are rearing natural predators of the adelgid. The predators are released on public lands, in the hope that these predators will multiply, disperse and protect forests and woodlands across the southeast.



STATE-FEDERAL COOPERATIVE PREVENTION PROGRAMS AIM TO WIN THE BATTLE AGAINST THE SOUTHERN PINE BEETLE

*Ronald Billings,
Texas Forest Service*

John Nowak, USDA Forest Service, Forest Health Protection

“In time of peace, prepare for war.” Winston Churchill’s famous message also applies to the southern pine beetle (SPB), the most destructive pest of pine forests in the southern U.S. Beginning in 2003, the USDA Forest Service, Forest Health Protection, and the Southern Group of State Foresters initiated the Southern Pine Beetle Prevention and Restoration Program. Objectives of this on-going program are to evaluate the current hazard for SPB, increase public awareness of SPB prevention practices, and provide incentives to forest landowners to “beetle-proof” their pine stands while SPB populations are at low levels. Funds also are available to help restore stands within those states devastated by the most recent SPB outbreaks.

Pine forests provide a major source of income, recreation and other benefits for a multitude of forest landowners and forest users in the South.

Unfortunately, these natural resources may be jeopardized periodically by destructive forces such as hurricanes, wildfires and the dreaded southern pine beetle. Currently, SPB populations are present at low levels in

most southern states, following unprecedented outbreaks from 1999 to 2002. In 2002, for example, South Carolina alone reported more than 67,000 SPB infestations and suffered losses in excess of \$265 million. In total, more than one million acres were affected in states east of the Mississippi River; the outbreak had an estimated economic impact of \$1.5 billion. Historically, SPB outbreaks have been cyclic, with infestations reaching peak levels every 6-9 years. Thus, pine forests in many states are

overdue for another outbreak. Dense, unthinned loblolly or shortleaf pine stands, particularly those on poorly-drained, bottomland sites, are known to be most susceptible to the occurrence and spread of SPB infestations along the lower Gulf Coast. Thinning is recognized as the most effective prevention measure for commercial pine stands.

To minimize the impact of future SPB outbreaks, the Region 8 unit of USDA Forest Service, Forest Health Protection is offering federal cost-share incentives to qualified landowners in 11 southern states to thin beetle-prone pine stands.

Participating states are taking multiple approaches to increase public awareness of the benefits of prevention practices for bark beetles. For example, the Florida Division of Forestry has erected a series of billboards with SPB prevention messages along major highways. To better reach underserved landowners, North Carolina has employed a cadre of SPB prevention foresters to deliver the prevention message throughout the state.

The Texas Forest Service, in turn, has established a demonstration area to showcase a recently-thinned stand on the W. Goodrich Jones State Forest near Houston in which a portion has been left unthinned for comparison.

Private landowners with small tracts qualify for cost shares if their young pine stands have never been thinned and meet the criterion of moderate or high hazard for SPB.

Emphasis for program funding has been towards on-the-ground accomplishments. From FY 2003 - FY 2005, more than 235,000 acres of high-hazard stands were treated on federal, state, and private lands, with an additional 150,000+ acres targeted in FY 2006.

For more information, contact John Nowak, SPB prevention program manager at (828) 257-4326 or jnowak@fs.fed.us or your State forestry agency.



Photo courtesy of Texas Forest Service

Equipped with a display and SPB prevention handouts, Texas Forest Service entomologist Joe Pase discusses SPB prevention with a landowner as part of the Family Forest Field Day, Oct. 14, 2006, on the W. Goodrich Jones State Forest near Houston.

FOREST SERVICE INSTITUTES A NON-NATIVE INVASIVE PLANT PROGRAM

John W. Taylor, integrated pest management specialist, Forest Health Protection, Atlanta, Ga.

Invasive non-native plants threaten the sustainability of our forest ecosystems regionally, nationally and globally. Non-native invasive plants have successfully invaded Southern forests, occupying habitat under and beneath tree canopies, occupying forest openings, and generally decreasing forest productivity. This has hindered forest use and management activities, causing degradation of diversity and wildlife habitat. Non-native invasive forest plants are increasing in their range and severity, and continue to spread virtually unchecked throughout Southern forest lands.

In 2003, the Forest Service developed a Strategic Plan for Non-Native Invasive Plant Management in the Southern Region. The Plan is designed to be implemented by working with our state forestry agencies in five areas: Prevention; Early Detection and Rapid Response; Control and Management; Rehabilitation and Restoration, and Information and Education.

We are working closely with interested user groups to form Cooperative Weed Management Areas as a way to focus efforts and resources on specific problems, such as cogongrass, kudzu, Chinese tallow, Chinese privet, and other non-native invasive plants. It is also important that land managers are aware which plant species possess invasive characteristics and which ones do not. This knowledge assists the land manager in avoiding the use of invasive species when planting choices are being made.

Successful and dependable early detection methods and the ability to make a rapid response to eradicate newly discovered infestations are key components of an effective non-native invasive plant containment program.

Control and management of non-native invasive species is an integral part of forest management, regardless of ownership. We are supporting development and publication of a compendium of Best Management Practices (BMPs), which provides the latest available information on control of invasive plants in forests, including techniques, tools and timing. The first publication in this series, entitled "Invasive Plant Responses to Silvicultural Practices in the South," was prepared by Chris Evans, Dr. Dave Morehead, and Chuck Barger of the University of Georgia. A second publication by the same authors is entitled "Field Guide to the Identification of Cogongrass." There are plans to add publications describing BMPs for controlling Japanese Climbing Fern, Tallow Tree and, possibly, Chinese Privet.

One of the most difficult decisions managers must make after removal of invasive species from a site is choosing which species to use to restore the area to its desired condition. There is a shortage of information and plant material available for land managers to make informed decisions. The Forest Service is actively engaged with our cooperators to identify alternative native species suitable for use in rehabilitation and restoration projects.

The Information and Education component of our Non-Native Invasive Plant Management Strategy is closely tied to and intertwined with, the other program components. Our efforts to support training of foresters, vegetation management personnel, and other interested parties have resulted in presentations to more than 3,000 attendees in the past three years.

The Forest Service has supported the creation of numerous brochures, pamphlets and posters describing the non-native invasive plant threat to our forests. This information is distributed to the public for free.



SOUTHERN RESEARCH STATION – RESEARCH HIGHLIGHTS

Aboveground sink strength in forests controls the allocation of carbon belowground and its CO₂-induced enhancement. Palmroth, Sari; Oren, Ram; McCarthy, Heather R. [and others]. 2006: Proceedings of National Academy of Sciences of United States of America. 103(51): 19362-19367. [Editor's note: Southern Research Station scientist Kurt H. Johnsen co-authored this paper.]

Researchers found that trees only increase wood growth from elevated CO₂ if there is enough leaf area to support that growth. The main constraint on leaf area development, and, thus, wood growth, is soil nutrition. Without adequate soil nutrition, trees largely respond to elevated CO₂ by transferring carbon belowground and recycling it back to the atmosphere through respiration. Thus, with sufficient soil nutrition, forests increase their ability to tie up, or sequester, increasing atmospheric CO₂ concentrations. Forests still sequester C with lower soil nutrition but cannot take advantage of steadily increasing atmospheric CO₂ due to increased use of fossil fuels. Many forests are deficient in soil nutrition, but forest management, including forest fertilization, can greatly increase growth rate and wood growth responses to elevated atmospheric CO₂.

<http://www.srs.fs.usda.gov/pubs/25250>

Monarch (*Danaus plexippus* L. Nymphalidae) migration, nectar resources, and fire regimes in the Ouachita Mountains of Arkansas. Rudolph, D. Craig; Ely, Charles A.; Schaefer, Richard R. [and others] Journal of Lepidopterists' Society. 60(3): 165-170.

Monarchs (*Danaus plexippus*) pass through the Ouachita Mountains in large numbers in September and October on their annual migration to overwintering sites in central Mexico. Monarchs depend on nectar resources to fuel their migratory movements, and they obtain nectar from a variety of plant species, especially tickseed sunflower (*Bidens aristosa*) and other composites. Research results suggest that widespread fire-suppression

since the early 1900s has substantially reduced nectar production for migrating monarchs in the Ouachita Mountains. Sites that are undergoing restoration to a shortleaf pine-bluestem grass community following thinning and frequent prescribed fire support increased abundances of nectar resources and migrating monarchs compared to untreated controls.

<http://www.srs.fs.usda.gov/pubs/24947>

Evaluation of Ikonos satellite imagery for detecting ice storm damage to oak forests in eastern Kentucky. McNab, W. Henry; Roof, Tracy; Lewis, Jeffrey F. 2006: In: Prisley, S.; Bettinger, P.; Hung, I-K.; Kushla, J., eds. Proceedings of 5th Southern Forestry and Natural Resources GIS conference. Athens, GA: Warnell School of Forestry and Natural Resources, University of Georgia: 128-138.

Ice storms are a recurring landscape-scale disturbance in the Eastern U.S. where they may cause varying levels of damage to upland hardwood forests. The extent and severity of storm damage in managed forests must be mapped and assessed so that economic loss can be estimated, products salvaged, and recovery activities planned. We evaluated high-resolution satellite imagery as a tool for detecting damage to an oak-dominated forest in eastern Kentucky that had been affected by an ice storm. Accuracy in classifying low- and high-levels of damage ranged from 65 to 70 percent. Our results suggest that high-resolution satellite imagery may be useful for detecting ice storm damage to upland hardwood forests.

<http://www.srs.fs.fed.us/pubs/26336>

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