Forest Health Review

May 2007

Emergent leaves of tree of heaven, left, and hickory were hard hit by a late frost during the second week of April.

In this issue...

Greetings

More and more these days, I am asked to give an opinion on the impacts of global warming on forest health. Along with the monthly weather, a discussion of climate change may become a regular part of the 'Updates' column given its recent media attention and, more importantly, its potential implications. No, I'm not an expert on the topic; who really is? But a rapidly changing climate will clearly have an impact on forest health, a fact that is probably obvious to most people who give it some thought. While I rely on the climatologists and modelers to forecast the extent, speed and dynamics of this change (an inexact science to be sure), natural resource professionals are in a position to speculate on what impact such changes will have on forest ecology and health. Notice, I said 'speculate.' I suppose the other impetus for this writing was that, like most of you, I noticed that we didn't have much of a winter this year. One cold month, February, and that was about it (the current cold spell in April not withstanding). What is shocking to me is that this pattern is starting to feel 'normal.' I just don't expect it to stay cold (as in, below freezing) for very long any more. It's not really surprising then that the National Arbor Day Foundation recently changed its plant hardiness zone map to reflect the recent warming trend. Check out the updated map on its Web site; large portions of many states have warmed one full hardiness zone, two zones in some areas. This suggests that the warmer weather is here to stay. The world has started talking about it, and so will I. I trust you will find this issue of Forest Health Review to be useful and informative.

Chris Asaro, forest health specialist

Climate Change and Forest Health

We all know it's been getting warmer. Global temperatures during the last 10 years are the warmest they've been in 12,000 years. Ice is rapidly melting the world over, from the Arctic to the Antarctic to the glaciers in Glacier National Park in Montana and the snows of Mount Kilimanjaro in Africa. If the average global temperature goes up another one degree Celsius, it will be the hottest it's been in the last 1.35 million years. Yes, dramatic climate changes have occurred throughout Earth's history, some of them relatively rapidly, but these were catastrophic events often associated with major extinctions. Yes, the human species did live through an ice age or two before it began to warm up about 16,000 years ago, but I suspect they were a little tougher than we are today, and 25 years of age was probably considered 'old' back then. Nor were they crowded into cities and coastlines by the millions, dependent on technology and the labor of others for food and water. So, the prospect of rapid climate change is a serious matter that gives us much to be concerned about.

What are the likely implications of climate change to forest health? It's difficult to predict exactly what will happen since we don't yet know to what degree changes will occur and how quickly. Some models predict that we will not only experience hotter weather, but also more frequent drought and more severe storms. A greater frequency of severe storms will obviously have a negative impact on forest health due to wind damage and flooding, as we saw along the Gulf Coast and hundreds of miles inland in the wake of Hurricane Katrina in 2005 (Note: This does not imply that global warming caused Hurricane Katrina per se, only that such severe

"Technology…the knack of so arranging the world that we need not experience it."

Max Frisch, 1957

storms might become more frequent). More frequent droughts and warmer temperatures in the western U.S. will reduce mountain snow-pack and significantly reduce the water flow critical to ecosystems and the growing human population. Warmer, drier temperatures will certainly lead to more frequent and damaging wildfires and will favor certain species over others. In Virginia, cove species with higher moisture requirements, such as sugar maple and American beech, may become less prevalent, while drier oak-pine habitat may proliferate. If significant change continues over the next few hundred years, we may lose certain species from the landscape entirely, particularly those that are at the extremes of their physiological tolerance, while other species from more southerly climates may move in.

The initial signs of a tree species in the process of shifting its range may be a slowly developing 'decline,' in which chronic disease, poor growth and other stressors lead to lethal insect infestations. Because of the relatively long life span of trees, such trends may be hard to measure within a single human lifetime. It may not be clear that a range shift is occurring until a whole generation of trees over a large area disappears, and no new generation of seedlings or saplings is present to replace them. Even so, there are other elements operating in the environment that may produce the same effect without global warming. For example, oak decline occurs in many locations in Virginia due to a variety of insect and disease problems, some of them exotic pests. In addition, oak regeneration has been poor in many locations due to heavy deer browse, fire suppression and competition from invasive weeds. In the short term, it will not be easy to separate out all of these environmental influences from the effects of climate change, as they are likely to interact in very complex ways.

Based on a number of carbon dioxide enrichment studies, increased carbon dioxide levels in the atmosphere are likely to increase tree growth rates in the short term, but in the long term, forest communities will become saturated with carbon dioxide as they adjust to the increased levels in the increased levels in the atmosphere. Over the next 100 years, climate change is likely to increase the geographic extent and productivity of forests. For example, the boreal forests of Canada and Russia are likely to extend their range farther north into what is now tree-less tundra. Some might conclude from this that a greater expansion of more productive forest might offset carbon dioxide levels since younger forests grow more vigorously and plants thus sequester more carbon from the atmosphere. However, much of this growth gain may be offset by increased disturbances, such as insect infestations, fires, storms and continued harvest and destruction of tropical rainforests, that release carbon dioxide. Other future changes in land use patterns, pollution levels, forest management practices and timber demand will interact with climate change to produce unpredictable results. While some areas become drier, others may become wetter. Where some areas become less productive, others may become more productive. While we can place some confidence in humankind's proven ability to adjust and adapt, the fear is that these changes are occurring so rapidly that the results could be catastrophic.

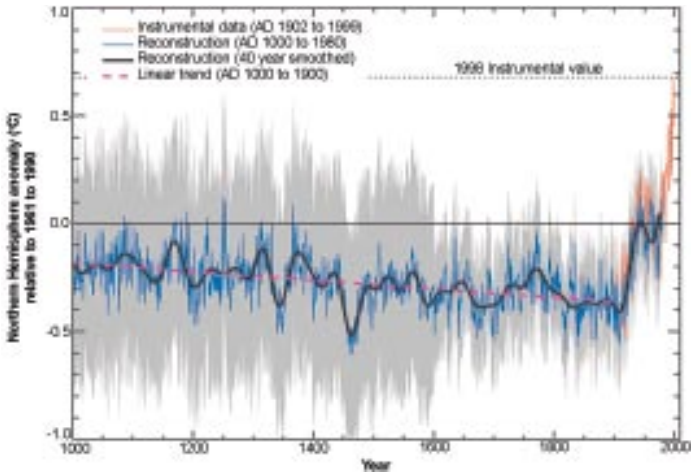

Figure 1. Temperature fluctuations in the Northern Hemisphere over the last 1,000 years. *Chart source: Northern Hemisphere Temperatures During the Past Millennium: Inferences, Uncertainties, and Limitations. By Mann, Bradley and Hughes, Geophysical Research Letters, Vol. 26, No. 6, P. 759.*

While changes in populations of long-lived trees may be difficult to measure in the short term, with short-lived, more rapidly reproducing organisms such as insects, we are already seeing observable

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"The art of being wise is the art of knowing what to overlook."

William James, 1890

UPDATES

Weather

In the last issue, we left off in September where we saw cooler than average temperatures and above average monthly precipitation thanks to Tropical Storm Ernesto's arrival at the beginning of the month. In October, temperatures remained slightly below average while precipitation continued to be well above normal (150 to 300+ percent of monthly average) for just about everyone. Warmer than average temperatures returned in November, with most locations being within a few degrees above average, while areas centered around Appomattox, Richmond and Culpeper averaged about five degrees above normal. Only Buchanan and Dickinson counties in the Southwest showed slightly below average temperatures. Precipitation during November was highly variable; the eastern two thirds of the state were 150 to 300 percent above average, highest in the southeast. Roanoke and Blacksburg south and west to the Grayson Highlands were average to a little above average, while the extreme southwest and a five-county area from Bedford north to Highland County were drier (50 to 90 percent of normal). Much warmer than average temperatures continued through December, averaging 4 to 6 degrees above normal for most and 6 to 10 degrees above normal for much of the area between Richmond, Charlottesville and Winchester. Precipitation was below average for everyone but lowest (25 to 50 percent of average) along a line from Pittsylvania County northeast through the Richmond and Fredericksburg areas.

Warm winter weather continued through January, averaging 4 to 6 degrees above normal in much of the western half of the state and the coastal counties, while most of northern Virginia south through the Richmond-Petersburg areas saw temperatures averaging 6 to 10 degrees above normal. Once again, precipitation

was highly variable, slightly above average in the Roanoke valley and to the north and south, along with the south-central piedmont to Richmond. Most other areas averaged 50 to 90 percent of normal precipitation. February brought with it significantly colder weather and, indeed, was the only month that truly felt like winter; most of the southern half of Virginia averaged 3 to 6 degrees below normal, and the area north of a line from Allegheny County to Albemarle to Westmoreland counties averaged 6 to 9 degrees below normal. Once again, precipitation was extremely variable. The driest areas were in the southwest, averaging 10 to 50 percent of normal monthly precipitation. Most other areas were 50 to 90 percent of normal. Much of northern Virginia as well as a six-county area centered on Farmville and a pocket over Bedford County, saw precipitation averaging 130 to 250 percent above normal. March brought back unusually warm temperatures, with most areas 2 to 6 degrees above average. A handful of counties scattered in the extreme southwest, Blacksburg area, and just west of Richmond were 6 to 8 degrees above average. Precipitation was between 70 to 90 percent of normal for March throughout much of the central and northern parts of the Commonwealth. Much of the southwest and east saw 50 to 70 percent of normal monthly precipitation, while the southeast was between 25 to 50 percent of normal.

"Human beings are perhaps never more frightening then when they are convinced beyond doubt that they are right."

Laurens van der Post, 1958

Late Freeze

A late cold spell hit in early April after very warm March weather led to slightly early leaf-out. On the first night of the cold spell, up to 1 to 3 inches of snow fell in many areas. The snow covering the new leaves was probably a benefit, insulating leaves from air temperatures that may have dipped below freezing. Although the snow quickly melted the next day, temperatures dipped below freezing on at least 3 to 4 subsequent nights in many locations. This has caused a great deal of localized damage to some of the delicate, recently emerged leaves on many trees. Black locust, tulip poplar, maple, black gum and hickory seemed to be particularly hard hit. Most oaks had not yet leafed out and therefore were ok. Many of these damaged leaves will be replaced and unnoticeable by mid-summer, although the appearance of many trees will be temporarily affected and may look pretty bad during the spring. Freeze-damage can sometimes lead to significant stress on a tree since energy is required to replace leaves. Often, greater susceptibility to fungal pathogens following a late freeze can contribute to a tree's decline.

Emergent leaves of locust, top, and tulip poplar were hard hit by a late frost during the second week of April.

Eastern Tent Caterpillar

The widespread appearance of tent caterpillar webbing in cherry trees is an annual rite of spring in Virginia. However, it seems to me that caterpillar populations are particularly high this year, or maybe I just haven't lived in Virginia long enough to be able to put this in perspective. Most cherries I see have at least a couple of webs, while many have 10 or 20 webs. I really have nothing more to add to this pretty familiar story.

Southern Pine Beetle

Although southern pine beetle (SPB) populations have been very low during the last few years, we did see increasing activity during 2006 in Chesterfield County in and around Pocahontas State Park and in southern Mecklenburg County around the John H. Kerr reservoir. These counties were still very far from being considered in 'outbreak' status, which is defined as a county having more than one multiple-tree SPB spot per 1,000 acres of host type in the county. We will likely continue to see increases in activity this year, particularly in those same general areas.

"The optimist proclaims that we live in the best of all possible worlds; and the pessimist fears that this is true."

James Branch Cabell, 1926

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The Southern Pine Beetle Prevention and Restoration Program, sponsored by the USDA Forest Service, continues to be well funded. Cost share for pre-commercial thinning has increased to more than 14,000 acres since 2004, while longleaf pine is being restored on 300 acres under the program. Longleaf pine forests were once widespread throughout the South, including the southeastern corner of Virginia. It is now relatively rare, but due to its resistance to the southern pine beetle and its association with rare and endangered species, such as the red-cockaded woodpecker, interest has been growing in restoring this species throughout the South wherever possible and desirable.

Gypsy Moth

Last year, gypsy moth populations surged in some locations, defoliating more than 14,000 acres in Frederick, Giles, Montgomery and Roanoke counties. Roanoke County was the hardest hit, with about 7,000 acres of private land heavily defoliated on Poor Mountain and Bent Mountain, just to the southwest of the City of Roanoke.

High egg mass counts in these locations portend at least a repeat of last year, if not significantly greater defoliation occurring. A lot depends on the weather. A fungus (*Entomophaga maimaiga*) that kills gypsy moth larvae has had severe impacts on gypsy moth populations during cool, wet spring weather. Unfortunately, the last couple of years have seen warm, dry spring weather and gypsy moth populations have resurged. As of this writing, gypsy moth eggs have not yet hatched, and much will depend on the weather following hatching.

European Woodwasp

We will continue to put out traps to detect the presence of *Sirex noctilio*, or the European woodwasp, which is a threat to our pine resource in Virginia. Right now, this invasive insect is established in New York and northern Pennsylvania, but has not yet been detected elsewhere. Thus far, its activity in New York appears to be more secondary on weakened host trees rather than acting as an aggressive insect that kills healthy pine. However, most of this pine in New York consists of white, red or Scotch pine. We don't really know what it will do to loblolly pine, which is reported to be a highly preferred host species. Fortunately, there is an effective biological control available if it does become established here, but we hope to not have to employ that strategy if we can avoid it as it will cost considerable time, effort and money to implement.

Sirex noctilio is thought to be a significant threat to loblolly pine.

"Integrity without knowledge is weak and useless, and knowledge without integrity is dangerous and dreadful."

Samuel Johnson, 1759

Hemlock Woolly Adelgid

In the April 2006 issue, I reported on the release of 300 *Laricobius nigrinus* beetles at James River State Park in an effort to control the growing population of hemlock woolly adelgid (HWA) in the park. This release occurred in the fall of 2005, and subsequent evaluations this spring have yielded recovery of a few beetle larvae, suggesting a successful establishment. It can take several years for populations to build up to numbers that are detectable from sampling. It is discouraging, however, that the condition of some hemlock trees continue to deteriorate, while the HWA population continues to expand to previously uninfested trees. Although many trees in the park still appear healthy and are putting out new growth, some of them are now so infested that they are unlikely to remain in this condition for long. Even if the beetles successfully establish themselves there, the prognosis for many of these hemlock trees is not very good. The hemlock population here is isolated and just east of the main hemlock range. Loss of hemlock here would be a particular shame due to its unique position covering the bluffs over the James River in a very scenic location.

Sudden Oak Death

We continue to monitor for sudden oak death (SOD), which has not been found in a natural forest anywhere in Virginia or the eastern U.S. In the previous issue (November 2006), I described a new stream sampling scheme for SOD that has now replaced the collecting of terrestrial leaf samples exhibiting suspect symptoms. This new sampling scheme is based on the biology of the SOD pathogen, *Phytophthora ramorum*, which has spores that swim and are spread by water. There are many native species of *Phytophthora* that also have waterborne spores; one notable example is *Phytophthora cinnamomi*, which causes little leaf disease in shortleaf and loblolly pines. It was discovered that these species can be detected by baiting a stream with rhododendron leaves. These leaves are placed in mesh bags and left in a stream for a couple of weeks. When the leaves are collected, they often contain black spots about ¼ inch in diameter that indicate an infection site. It's not possible to tell what species of *Phtyophthora* caused the infection by simply looking at the spots, but the leaf tissue can be isolated in a laboratory and the species can be identified by DNA analysis. This procedure will work equally well if *Phytophthora ramorum* is present in our streams. If it is present in the streams, that means it is present in the woods. By sampling downstream of a large watershed, samples taken in this way can represent 5,000 to 10,000 acres each, which is a more efficient way to sample a large area for the presence of this pathogen.

"Every man, wherever he goes, is encompassed by a cloud of comforting convictions, which move with him like flies on a summer day."

Bertrand Russell, 1928

UPDATES

Tree of Heaven

In the April 2006 issue of the Forest Health Review, I talked about some of the work we are doing with *Ailanthus altissima* – potential uses and markets for the wood and control strategies. We will continue with that work this year. In particular, we will continue to kill and remove *Ailanthus* from locations surrounding our Central Office in Charlottesville, as well as some other locations. Some of the wood from these trees will be sawn into boards and sent to Virginia Tech for study of wood properties and optimum kiln drying schedules. Last year, we treated *Ailanthus* with Garlon IV during June and July, with very little re-sprouting apparent (see Forest Research Review, March 2007), although a final resprouting check will occur in May. This year, we treated some trees during March. Garlon has already been established as effective when applied during the winter. It will be interesting and significant to see whether effective control with Garlon can be achieved during ANY time of year.

Invasive Plant Interpretive Trail

As a follow up to some of the *Ailanthus* control work around the Central Office, we are going to need to combat some other encroaching invasive weeds before restoring these sites to a more natural condition. These weeds include multiflora rose, Japanese honeysuckle, oriental bittersweet and autumn olive, among others. In addition, we are planning on establishing an invasive species interpretive trail in the woods surrounding Central Office. This trail will overlap a pre-existing interpretive trail that highlights different facets of the forest and its ecology. Because we have an abundance of about 12 to 15 very common invasive plants all along the trail, this provides an excellent opportunity to educate the public on recognizing these weeds and understanding their impacts on Virginia's forests. The trail will consist of red wooden posts with letters, each post associated with a different weed species or the same weed at varying stages of encroachment. A trail guide will be available containing a narrative and photographs to go along with each lettered post. People hiking the trail with the guide will quickly learn to recognize these weeds and see how truly ubiquitous they are. The goal is to provide the public with an understanding of the detrimental effects these invasive plants have on the health of our forests and to perhaps encourage them to manage or eliminate these weeds from their own property. It might also discourage them from purchasing and propagating some popular gardening plants, such as English Ivy, which has become a significant problem.

A forest floor near Charlottesville carpeted with periwinkle (Vinca minor), a non-native invasive weed.

"No one means all he says, and yet very few say all they mean, for words are slippery and thought is viscous."

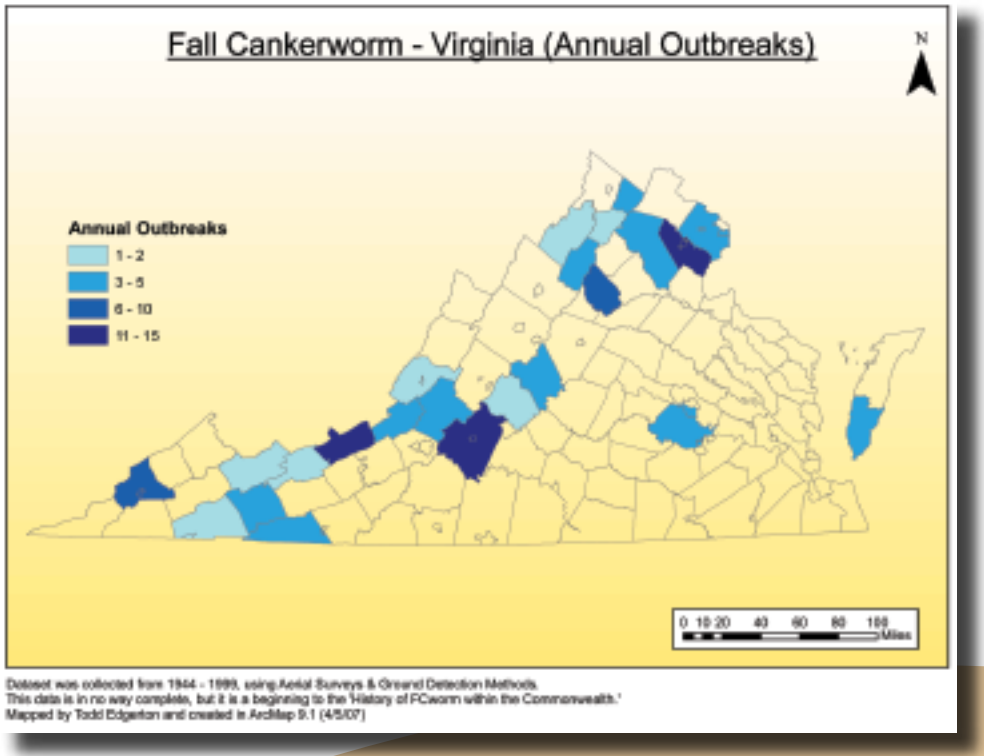
Henry Brooks Adams, 1907

Fall Cankerworm Outbreaks in Virginia

The fall cankerworm (*Alsophila pometaria*) is a very common spring defoliator. Next to the gypsy moth, it is probably Virginia's most damaging defoliator in terms of the extent and frequency of outbreaks. It also has a very broad host range, including oaks, hickories, maples, ash and beech. Unlike the gypsy moth, it is a native insect. The name 'fall cankerworm' comes from the fact that adult moths are active during the fall; the female adults are wingless and can be seen crawling about on trees and laying their eggs during November and December. Larvae hatch in early spring following budbreak and feed on expanding leaves. In Virginia, larvae feed from about mid-April through May, and subsequently pupate in the soil until adults emerge again during late autumn. Full grown larvae are loopers with three pairs of prolegs, a small pair on the fifth abdominal segment and larger pairs on the sixth and last segments. Color variation is extensive and is associated with population density. In low populations, larvae are pale green with longitudinal white lines down the body. At higher densities, larval coloration is darker and a black stripe extends down the back of the larvae. After a year or two of heavy defoliation, an egg parasite and diseases often cause populations to crash.

Normally, heavy defoliation becomes visible a couple of weeks before gypsy moth defoliation – about late May to early June in Virginia. By about mid-June, defoliation from either of these pests cannot be distinguished from the air, and one must then ground-truth to determine the cause. Most major fall cankerworm outbreaks occur in the mountains at or near the ridge line. VDOF has records of fall cankerworm outbreaks going back to 1944. Figure 1 shows the relative frequency of reported outbreaks in Virginia by county from 1944 to 1999. Interestingly, outbreaks tend to recur in the same locations, perhaps due in part to the tendency of females to lay eggs on the same trees on which they fed as larvae. Hot spots seem to be Bull Run Mountain in Fauquier and Prince William counties, Bedford County near the Peaks of Otter and Giles County. I'm not sure why these areas repeatedly see the worst defoliation. To some extent though, this map is an artifact of what has been reported, so it's also possible that underreporting has occurred in historically more remote, less visible counties, such as Bath and Highland in western Virginia.

Another looper, the spring cankerworm (*Paleacrita vernata*), has a very similar life cycle. Adult moths (also wingless) lay their eggs in late February or March instead of fall, but larvae emerge at about the same time and feed on similar hosts. Spring cankerworms have two pairs of prolegs instead of three. Larval color also varies depending on density, from reddish to yellowish brown, yellowish green, or black.



The distribution and number of fall cankerworm outbreaks by Virginia county during the period 1944 to 1999.

"When everyone is wrong, everyone is right."

Nivelle da la Chaussée, 1747

Emerald Ash Borer Rears Its Ugly Green Head In Maryland

The emerald ash borer (EAB) is right on our doorstep. In Prince George's County, Maryland, just south of the DC area and north of Waldorf, the Maryland Department of Agriculture (MDA) has undertaken an enormous effort to eradicate the beetle. This is the second eradication attempt; the first one occurred three years ago and was seemingly successful until the beetle was spotted again during August 2006. The rediscovery occurred very close to the original eradication zone and, in some locations, the infestation appeared to be at least a couple of years old. This suggests that the original eradication was not completely successful.

This past winter, MDA personnel, along with a slew of volunteers from other states, have scoured an area of approximately 25 square miles surrounding the original eradication zone. The intent was to locate and record all ash trees within that zone, and remove and destroy any infested ash trees before the emerald ash borer adults begin to emerge from infested trees in April. I had an opportunity to participate in this effort for a day and was impressed with the enormity of the task. There were volunteers from state forestry departments from Delaware, West Virginia, Pennsylvania, New Jersey and New York, among others. Some of these volunteers were present for a week or more. All of the participants met daily at the MDA Warehouse off Route 301 to gather equipment and be placed into work crews. Each crew, usually about 10 to 15 people led by an MDA official, was then sent to a particular location to begin systematically surveying a series of adjacent 2½-acre grids. Every ash tree encountered was entered into a GPS. The number of ash trees found in a grid varied from none to many, and the environment varied from highly residential/urban to heavily wooded. There were thousands of grids to be completed and hundreds of ash trees to be removed. The logistical complications involved in coordinating this effort were enormous, particularly navigating through mostly private property. MDA did mail out notices to all residents in

An unusually heavy concentration of ash trees near Waldorf, MD, most of which have evidence of current or previous infestation by the emerald ash borer.

All infested ash are brought to this marshaling yard run by the Maryland Department of Agriculture and destroyed in a chipper.

"The importance of a scientific work can be measured by the number of previous publications it makes superfluous to read."

David Hilbert, 1862-1943

the affected survey area, but not everyone got the message! Most folks were friendly and understanding once they knew who we were and what we were doing. Funding for this effort was provided by the US Animal and Plant Health Inspection Service (APHIS).

What about Virginia? Well, let's go back to the summer of 2003, when a Michigan nursery owner violated federal quarantine laws by shipping hundreds of infested ash trees to a nursery in Prince George's County, Maryland. This nursery, in turn, sold 16 infested trees to Fairfax County Public Schools, which were planted at the Colvin Run Elementary School near Wolf Trap Park. In October, the Virginia Department of Agriculture and Consumer Services (VDACS) and the Fairfax County Forest Pest Program became aware of the EAB-infested trees. Upon inspection, these trees were found to have feeding galleries and adult exit holes, indicating these insects may have spread. An eradication program was then initiated in the spring of 2004, whereby 238 ash trees were removed and destroyed within a one-half mile buffer zone around the original infestation. Some of this effort was supported by the USDA Forest Service. Subsequent surveys using a network of sentinel ash trees planted throughout Fairfax County have revealed no new infestations. These sentinel trees are girdled and left to slowly die during the spring and summer. The dying trees release volatile compounds that attract the insect, if present in the area. The trees are then harvested by September and carefully dissected to look for any evidence of EAB larval galleries (see EAB update in the November 2006 issue of the Forest Health Review). VDACS, Fairfax County Pest Program personnel and VDOF will continue to vigorously survey for this pest, particularly in counties within and surrounding the DC metro area and Potomac River.

We can only hope that the Maryland eradication effort is successful, but one does wonder whether this effort is just delaying the inevitable. If one infested tree is missed, it may undermine the entire operation. Furthermore, if the original eradication effort in 2003 proved to be unsuccessful when a much smaller eradication zone was in effect, how likely is the current effort going to succeed? And even if it does, EAB is infesting much of the mid-west, where eradication is no longer an option for states like Michigan, Indiana and Ohio because the infested area is simply too large. There is very little to stop this EAB population from gradually spreading towards Virginia by moving in through adjacent states. In fact, EAB may eventually find its way into Virginia by a traveler or camper who unknowingly brings in infested firewood from outside the Commonwealth. Other wood-infesting invasive pests, such as the Asian longhorned beetle (ALB) and the European woodwasp, can also be easily spread in this manner. Recently, VDOF along with VDACS, Virginia Cooperative Extension and the Virginia Department of Conservation and Recreation have joined efforts to create and distribute a poster highlighting the dangers associated with moving firewood, similar to efforts in other states.

In the mean time, the general consensus is that EAB is here to stay, very likely to spread, and the future of the ash tree (all species) is rather grim. Although only about one percent of the timber volume in Virginia is ash, according to FIA data, it is a high-value crop tree. Ash is also very widely used in urban forests and riparian buffers, although quantitative data on these uses is limited for Virginia. I encourage folks to not only stop planting ash, but to plan to eventually lose the ash you have and replace it with something appropriate for the site. For that matter, many cities have emphasized ashes and maples over many other species, and maples are also under future threat from the Asian longhorned beetle. While eradication efforts for ALB are ongoing in cities, such as Chicago, New York and Jersey City – many experts also believe it is a matter of time before this beetle becomes established in the U.S. and spreads as well. While I think it is premature to suggest we stop planting maple in our cities, it might not be a bad idea to not put all of our eggs in that basket. Diversity is the key, since most trees are vulnerable to something. While I know all of this sounds very pessimistic, we should always be prepared for the worst case scenario as such actions now will save time and money in the long term.

"It is only with the heart that one can see rightly; what is essential is invisible to the eye."

Antoine de Saint-Exupéry, 1943

Climate Change and Forest Health, continued

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changes tied to a warmer climate; shorter generation times; more generations per year, and range shifts to more northerly latitudes and higher elevations. Such phenomena are thought to be partly responsible for the unprecedented mountain pine beetle outbreak under way in many western states and British Columbia. Unprecedented acres of lodgepole and ponderosa pine forests are being decimated by the beetle; a lack of severe winter weather is contributing to its unchecked population explosion. In addition, white bark pine, an important keystone species in sub-alpine ecosystems in the western U.S., is under significant threat by mountain pine beetle as never before because the beetle has recently been able to thrive at higher altitudes than normal where white bark pine predominates. Mountain pine beetle has also expanded its range northeastwards, threatening areas that have probably never harbored this insect since the last glacial retreat about 20,000 years ago.

In general, trees under stress will become more susceptible to insect infestations, so we may see an increase in the number and severity of outbreaks of native species that typically haven't been that serious in the past. For example, during the last decade, the red oak borer has decimated the oak-dominated forests of the Ozarks in Arkansas, reaching populations substantially greater than anything that has ever been observed. While no one is certain what led to this outbreak, aging oak forests on poor soils combined with other stress factors, such as drought, probably played a big role. Virginia's oak-hickory forests have also seen considerable damage from the red oak borer in recent years in association with oak decline, although nothing like what was observed in Arkansas.

Although the two examples above concern native insects, invasive species are likely to interact with climate change in complex and unpredictable ways as well. While climate change cannot be unequivocally tied to these particular examples any more than we can tie it to a single category five hurricane, it is not unreasonable to suggest we might see more such 'unprecedented' events in a warmer, drier, more dynamic world. Generally speaking, rapid climate change will probably have more negative than positive impacts on forest health as long-lived trees and forests struggle to adjust to rapidly changing conditions. We may have to get used to a new 'normal' in terms of climate and the state of our forests, although the only thing that may feel normal to us is constant change.

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