Forest Health Review

April 2006

In this issue...

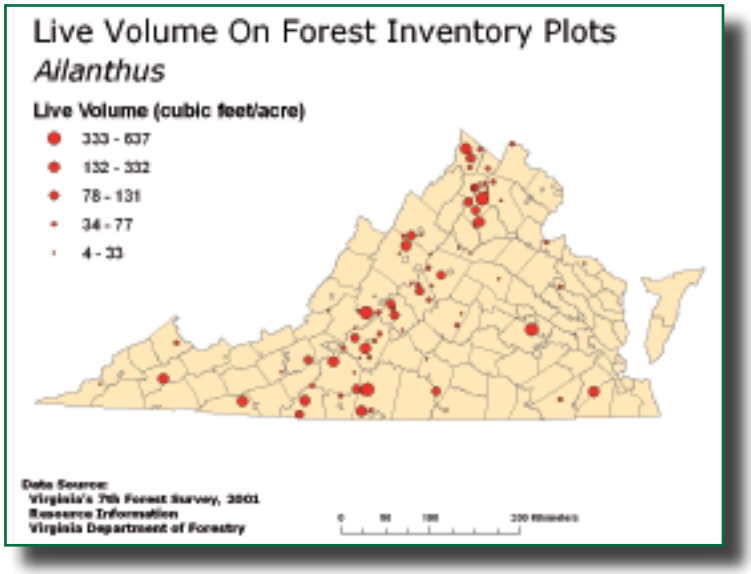
Greetings

As I write this issue, we are experiencing a significant drought throughout the Commonwealth. Last March was one of the driest on record, with many areas receiving 0-10% of normal monthly rainfall. Virginia has already had more fires this year than all of last year. This comes on the heels of a very dry 2005. Drought is one of the most common stress factors in the landscape, and can have both short-term and long-term effects on forest health. Future projections suggest that this dry weather will continue through June, returning to a more normal pattern by July. In the mean time, we will likely continue to see above average levels of pine and hardwood mortality. Many trees are still suffering the effects of drought and severe storms from years past. Forest insect and disease problems typically follow such extreme events. When it comes to weather, no news is good news, so here's hoping for an average year. I hope you find this issue to be useful and informative.

Chris Asaro, forest health specialist

Control And Utilization of Tree of Heaven

Tree of heaven (Ailanthus altissima) is native to China and was first introduced to the United States from England to Philadelphia, Pennsylvania, in 1784. It was widely planted in cities the following century as an urban and shelterbelt tree due to its tolerance to drought, poor soils and air pollution. It has since become naturalized in 42 states due to prolific growth and regeneration via root sprouting and heavy seed production. Its unpleasant odor further lends credence to its status as a 'weed tree.' Tree of heaven (TOH) is in more than 35 Virginia counties based on current FIA inventory data, and is mostly found in disturbed habitat, particularly along highway and roadway corridors and medians. Increasingly, it is invading interior forest habitat where canopy gaps occur. State-wide volumes are over 48 million cubic feet, concentrated primarily along the Blue Ridge Mountains and the I-81 and Route 29 corridors (see figure). This represents approximately 0.15% of the 31 billion cubic feet of merchantable volume in Virginia, making Ailanthus the 46th most abundant tree out of a list of 104 tree species for the Commonwealth.



Although there are many invasive plants to contend with in Virginia, TOH is considered the most serious woody invasive. An informal VDOF survey of Virginia state

"What is a weed? A plant whose virtues have not been discovered."

Ralph Waldo Emerson, 1878

Control and Utilization of Tree of Heaven, continued

employees representing multiple agencies involved in natural resource management lists TOH as one of the top invasive species problems in the Commonwealth. Because TOH has become so naturalized, eradication of this species is not really a viable option. However, one approach to control, which has been little explored to date, is developing markets for woody invasive species such as Ailanthus, Paulownia tomentosa (Princess tree) and Albizia julibrissin (Mimosa or silk tree). Charlie Becker, VDOF wood utilization and marketing specialist, reports that all of these species have now attained the volume and size in places to have potential use. Since most of the forest land in Virginia is owned by private individuals, anything that can provide additional income or reduce the cost of management will increase the incentive to control invasive species.

Charlie and I have recently received a small grant from the USDA Forest Service, Forest Health Protection unit, to begin research exploring the potential of this idea. Our proposal was based on some preliminary work done by Charlie and researchers at Virginia Tech's College of Natural Resources in which they harvested large Ailanthus trees and produced boards of numerous sizes. Although its mechanical properties are still being evaluated, the wood appears somewhat similar to ash. In addition, slabs from the sawing were used to create a high-quality charcoal in a portable charcoal kiln. Further investigations will explore the potential for use as pulpwood or as a potential component of the expanding market for biomass fuels.

Of course, development of markets will not act as a useful control strategy by itself unless reliable methods are developed to prevent resprouting of TOH from stumps. Therefore, Jerre Creighton, VDOF tree improvement research manager, will be exploring what chemical and mechanical methods are optimal for treating stumps and preventing resprouting. Chemically treating trees prior to cutting is one possibility being explored. Some of this research will be carried out at VDOF central office in Charlottesville, where there is plenty of Ailanthus. We will also be experimenting with control on the property of a nearby landowner. Sometime this year, we hope to set up a demonstration area near our central office displaying some of the various products produced from TOH and discussing control options with landowners. Ultimately, we hope this strategy leads to reducing the prevalence and/or limiting the spread of Ailanthus. We think this approach has the potential to generate much interest among landowners, governments, conservation agencies and environmental groups.

Some have expressed concern that a viable market for Ailanthus products might lead to further cultivation of this species for profit. This seems unlikely because any viable uses that arise from this species will make use of existing markets, which are not solely dependent on a few species but can make use of it if it becomes available. Further, it is unlikely that TOH would attain a value that would make it highly profitable to actively cultivate. The goal would simply be to have a landowner offset some of the control costs. The apparent desire to get rid of TOH in many locations seems strong, and it is felt that few people would be interested in spreading this species any further.

"Education is what survives when what has been learned has been forgotten."

B.F. Skinner, 1969

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Weather

In the last report, we were closing out an unusually hot and dry summer and entering September with drought conditions in many areas. September saw continued drought and elevated temperatures. A majority of the Commonwealth saw precipitation levels at 25-50% of normal, with many areas well below that. Temperatures were 2-4 degrees (F) above normal in most locations, while in the eastern Piedmont and Coastal Plain they were 4-8 degrees above normal. The arrival of a major tropical system in mid-October brought much-needed drought relief and saved us from what was shaping up to be a very bad fall fire season. Monthly precipitation averages for much of central and northern Virginia were 150-300% above normal. Other areas saw near normal rainfall amounts, while the southwest remained somewhat dry, with monthly totals at 25-75% of normal. Temperatures remained elevated, averaging 2-4 degrees above normal for the month. During November, temperature and precipitation levels were pretty close to average for most locations, with extreme southwest Virginia continuing to be somewhat dry. December brought uniformly frigid weather, with most locations 2-4 degrees below normal and a few isolated pockets averaging 4-6 degrees below normal for the month. Precipitation was average to 50% below average in much of the west and north, while the eastern portions of the Commonwealth were average to 200% above average.

January 2006 brought record-setting high temperatures to much of the country, and Virginia was no exception. Much of the Commonwealth was 4-8 degrees above average, with some areas in the north, central and southwest averaging 8-12 degrees above average for the month. Somewhat dry conditions continued for most areas, averaging 50-90% of normal,

with a few pockets along the Eastern Shore and southwest seeing normal to slightly above normal precipitation. Temperatures during February were pretty close to average or slightly above average in most locations. During March, temperatures ranged from 1-3 degrees below average in the southwest, normal to 1-2 degrees above average for most other areas, and a few pockets near Richmond and D.C. that were 3-4 degrees above average. Drought conditions continued through February and March, setting record low rainfall totals across the Commonwealth. During these two months, most areas saw precipitation levels that averaged 25-50% of normal, while much of southeast Virginia saw levels that were 25% of normal. Extreme southwest Virginia faired somewhat better during this time period, with most areas seeing 50-70% of average precipitation levels. Statewide, this has been the driest March since records have been kept for more than 100 years. As of this writing, minimal rainfall continues into April, and drought this year will likely have numerous impacts on forest health.

Pine Bark Beetles

What kind of year will it be for bark beetles? Many say we are 'due' for another southern pine beetle (SPB) outbreak, which may be true based on time elapsed since the last major one in the early 1990s. However, given the very low numbers last year, it is unlikely we would transition to a full scale outbreak in one year; populations often take multiple years to build up to outbreak levels.

"Fools ask questions that wise men cannot answer."

Anonymous

That said, the continuation of drought conditions will not help pine trees ward off bark beetle attacks due to decreased resin pressure, so pine mortality is likely to increase. In fact, scattered, widespread pine mortality (including loblolly, shortleaf, Virginia and white pine), mostly from pine engraver beetles (Ips spp.), occurred late last year during a drought that extended into the fall. Many attacks likely occurred towards the end of the growing season, so pine trees did not start turning color until late-winter and are just now being noticed. In most cases, dead trees were not numerous enough to affect overall stocking levels. Although these occurrences are fairly normal and do not necessarily portend a major bark beetle outbreak this year, they do suggest a lot of stress is occurring in the landscape. White pine, normally fairly resistant to bark beetles, has really taken a hit this past year in many locations, probably due to a combination of drought stress and overstocked stands.

Although spots with Ips attacks can be widespread and result in heavy losses, these spots normally die out without requiring intervention. Southern pine beetle spots, however, can grow substantially under the right conditions if left unchecked. The only way to obtain a general idea of what kind of year it will be for SPB is to trap them weekly from about mid-April to mid-May during their spring dispersal phase. Dispersing beetles are collected in multiple funnel traps placed in pine stands throughout Virginia. These traps are baited with the SPB pheromone (frontalin) and turpentine, and also attract the major SPB predator, another type of beetle called a checkered beetle or clerid. The total number of each of these two beetle species caught and their ratio gives us a pretty good idea of whether populations will be generally low, moderate, heavy, increasing, stable or decreasing. This information should be available by the middle of May.

Southern Pine Beetle Prevention

Pre-commercial thinning is an important technique for preventing or mitigating the impact of the southern pine beetle. Lower density stands result in more sunlight, water, and nutrients for the remaining trees. Healthier trees are better able to withstand an attack by SPB. In addition, SPB adults have to travel greater distances between trees, thus wider tree spacing can slow the spread of an infestation. The Virginia Department of Forestry continues to receive substantial funds from the USDA Forest Service, Forest Health Protection unit, to support cost-sharing with landowners for pre-commercial thinning jobs. Since 2003, we have supported pre-commercial thinning on more than 8,000 acres of mostly loblolly pine. VDOF foresters have done a great job encouraging landowners to sign up for this program, and they are encouraged to continue with this effort. In addition, this funding supports our efforts to conserve and propagate our native longleaf pine, as well as cost-share with any landowners interested in restoring longleaf pine on appropriate sites. Longleaf pine is highly resistant to SPB attack,

"Discovery consists of seeing what everybody has seen and thinking what nobody has thought."

Albert von Szent-Gyorgyi, 1962

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and therefore its re-establishment acts as a preventative measure. In addition, it provides an opportunity to restore longleaf pine habitat, a very species-rich ecosystem that once dominated much of the southeastern landscape. The Virginia Department of Conservation and Recreation (VDCR) is also a valuable partner in this effort.

Gypsy Moth

Sustained dry weather during the spring often portends increased gypsy moth activity. A fungal disease of gypsy moth, known as Entomophaga maimaiga, helps keep gypsy moth populations down during wet years. Heavy rainfall can also dislodge many young larvae from trees, often resulting in mortality. Finally, trees are generally under less stress during wet years and are better able to withstand defoliation. During the spring and summer of 2003-2004, frequent heavy rainfall across Virginia resulted in very little reported defoliation from gypsy moth. Dry weather returned in 2005, and populations rebounded somewhat, although not enough to cause widespread heavy defoliation. However, this buildup is significant in that it sets the stage for an even more significant population upswing in 2006, particularly if very dry conditions continue, which seems very likely as of this writing.

Bagworms

Bagworms were locally heavy throughout the central Piedmont last year. Bagworms have hundreds of host species but are most common to cedars, junipers and arborvitae. Normally they are no more than a cosmetic problem and their numbers are regulated by parasitic insects, but their numbers can sometimes become severe and lead to tree mortality. For smaller trees and low to moderate infestations, simply picking the bags off the trees and destroying them is one low impact way to manage bagworms. Alternatively, they are easily controlled with insecticides.

Eastern Tent Caterpillar

Seemingly overnight, their webs are everywhere. Eastern tent caterpillars are on the march this spring, stripping roadside cherry trees of their freshly emergent leaves. They will also feed on apples, crabapples, and a variety of other hardwoods. They likely benefit from all of this warm, dry weather. Although a tree stripped bare of its leaves seems serious, the tree will normally refoliate. Control is not generally necessary, but insecticides can be used on fruit trees. Alternatively, on smaller trees, webs or caterpillars can also be removed manually and destroyed.

"If you want to be adored by your peers and have standing ovations wherever you go, live to be over 90."

George Abbot, 1995

Oak Decline

In the previous issue (September, 2005), I discussed in detail some of the many causes of oak decline and mortality. I also described the effects of multiple years of drought, flooding and storms on many landscape trees that finally succumbed to insects and diseases during the hot, dry summer of 2005, particularly in eastern Virginia. In natural forests, oak decline is normally associated with mountainous areas with poor, shallow soils and frequent insect defoliation.

It is important to realize that tree health is not always indicative of current conditions. Therefore, even if temperature or rainfall patterns return to normal this year (which they don't seem to be doing as of this writing), we may continue to see tree mortality due to past events. I anticipate that the unusually high rates of mortality to oaks and other hardwoods, particularly among yard and landscape trees, will continue through this year. Dead and dying oak trees will likely be impacted by a variety of agents, including wood boring insects, ambrosia beetles, shoe-string fungus (Armillaria) and hypoxylon canker. Tree stress in the yard or landscape can often be prevented or alleviated by drip irrigation, fertilizing, and mulching to protect the root system from mechanical injury and low soil moisture.

Pine Bark Adelgid

The pine bark adelgid (Pineus strobi) has been observed on white pine in many locations across Virginia. This tiny, sapsucking insect normally feeds through the bark on the main bole of the tree. It secretes a white, waxy material over its body and at high densities, the boles of the tree can have a whitewashed appearance (see photo on cover). Although repeated, heavy infestations can lead to mortality of small trees and seedlings, these can be protected with insecticides. The adelgid normally does not have a major impact to trees in the forest. However, their presence can be a symptom of underlying stress. In a number of instances, mortality in white pine stands in which the adelgid was present was likely due to drought stress and subsequent attack by Ips bark beetles, rather than the adelgid itself.

Hemlock Woolly Adelgid

In 2005, Russell, Tazewell and Buckingham counties were added to the list of infested counties in Virginia. Lee, Wise, Dickenson, Buchanan, and Scott counties were surveyed but no hemlock woolly adelgid (HWA) was detected. These surveys are supported by the US Forest Service, Forest Health Protection unit.

The infestation detected in Buckingham County presents an interesting situation. Within Virginia, eastern hemlock is present in isolated pockets as you move farther east from the Blue Ridge Mountains. In James River State Park in Buckingham County, an isolated population of hemlocks exists along the bluffs on the southeastern side of the James River where it joins the Tye River. Outside of this location, there are very few hemlocks to be seen anywhere until one heads about 5-10 miles west, on the other side of the James.

This isolated stand has a light infestation of HWA but the trees still appear healthy. In theory, these are ideal circumstances for releasing predatory beetles as biological control agents – enough adelgids for predators to feed on but not so many that the beetles are overwhelmed and have little impact on the adelgid population. In addition, once trees begin to

"In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurs."

Frances Darwin, 1914

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decline from heavy adelgid infestations and no new growth is formed, the adelgids themselves suffer from malnutrition and represent a poorer diet for the predators, which in turn produce fewer eggs.

One of the biological control agents being released against the adelgid is a tiny beetle called Laricobius nigrinus, which is believed to be native to the northwest coast of North America. This beetle is being studied and mass reared at Virginia Tech by Scott Salom's lab in the Department of Entomology. This lab provides cooperators from many states with beetles to release in the field. Initial studies have shown that they successfully feed, mate and reproduce in the field, although it remains to be seen whether this effort in combination with releases of other predatory species will ultimately be successful at suppressing and maintaining HWA at non-damaging levels. Virginia Tech was kind enough to loan us 300 Laricobius beetles and, along with VDCR State Park representatives, assist us with a release at James River State Park. Due to the isolated nature of this hemlock population, the predators have no place else to go; therefore, this will serve as an interesting experiment to see whether the release will have a local impact on an early HWA infestation. Due to the extensive amount of hemlock mortality throughout the state, protecting isolated populations such as this might be a good strategy if it proves effective.

Sudden Oak Death

We continue to receive USDA Forest Service funds to conduct surveys for Phytophthora ramorum, the pathogen that causes sudden oak death, throughout the Commonwealth. Currently, the only known infestations in forested areas of the United States are in California and Oregon. Unfortunately, the disease can be spread by a long list of nursery grown plants that are not killed by the disease but act as carriers. These plants, which include azaleas and camellias, are grown in nurseries in California and shipped all over the country. Fortunately, since the problem has been identified, nurseries have become vigilant at screening all material before it is shipped elsewhere, thus greatly lowering the rate at which infected plants are spread around.

Our survey sites include general forested areas and nursery perimeters. There are many different species of pathogens within the genus Phytophthora that are native to our forests. These organisms have spores that can swim, and are therefore spread through watersheds and wet soils. Recently, it was discovered that many species of Phytophthora spores can be collected off of leaves found in streams. Thus, a new method of surveying for sudden oak death is being tested this year by baiting streams with fresh leaves of rhododendron and mountain laurel and having them collected and tested for the presence of P. ramorum. The benefit of this method is that a watershed containing infected leaves represents a much larger sampling area than a point-location where leaves are collected from only a handful of plants over a limited area.

"Nothing is more dangerous than an idea, when you have only one idea."

Emile-Auguste Chartier, 1938

Emerald Ash Borer

Despite a drop in federal funding, surveys for emerald ash borer will continue in 2006. The Virginia Department of Agriculture (VDACS) is also cooperating in this effort. Emerald ash borer would be devastating to all ash trees if introduced into Virginia. Fortunately, an isolated introduction of this pest in Fairfax County in 2003 was discovered early and seemingly eradicated since no infestations have been discovered since that time. Currently, emerald ash borer infests a large area of the Midwest, particularly Michigan, where tens of millions of ash trees have been destroyed since 2002 when the insect was first detected. It is now certain that the insect had been there for some time prior to its discovery. However, since nobody was looking for it, it went unnoticed until it was too late to contain it.

European Woodwasp

The European woodwasp (Sirex noctilio) represents yet another threat to Virginia's forests. This pine pest, closely related to sawflies, has wreaked havoc in exotic pine plantations in southern hemisphere countries such Australia, New Zealand, Uruguay, Argentina, Brazil, Chile and South Africa. Most of these plantations were of loblolly and Monterey pine. In its native range in Europe, Asia and northern Africa, it is considered a secondary pest on Scotch, Austrian, and maritime pines.

The first discovery of Sirex in North America occurred in upstate New York as recently as 2005. Subsequent surveys found it to be widespread within a five county area of the state. Thus, containment and eradication of this pest will be next to impossible. In addition to spreading over land, it may also be spread to other parts of the country via wood-packing material coming in at major ports of entry.

First the bad news: Sirex woodwasps can attack living pines, and loblolly pine is a preferred host. At low populations, however, they select suppressed, stressed and injured trees for egg laying. Using a long, thin structure called an ovipositor, the female woodwasp lays her eggs by drilling into the outer sapwood. Along with the egg, they inject a symbiotic fungus and toxic mucus into the tree. The fungus and mucus collectively kill the tree and provide a suitable environment for the larvae to develop. As larvae tunnel through the wood, they feed on the fungus that was injected into the tree by the adult female.

The good news: successful control of Sirex in Australia and other areas has been achieved using biological controls. The main agent is a parasitic nematode (a microscopic worm-like organism) which infects woodwasp larvae and causes sterilization in adult females. Infected females lay sterile eggs filled with nematodes thereby spreading the organism. Ultimately, Sirex populations can be reduced to non-damaging levels.

The Virginia Department of Forestry will be conducting trapping surveys for Sirex noctilio in 2006 throughout Virginia, supported by funding from the US Forest Service, Forest Health Protection unit. VDACS is also cooperating in this effort via other sources of funding. As with any exotic pest, the key to prevention is early detection and an aggressive eradication program, before the pest has a chance to become well established. The emerald ash borer effort in Fairfax County was an excellent example of this.

"Never, no never, did Nature say one thing and Wisdom say another."

Edmund Burke, 1797

The Vole Problem, Revisited

Voles have recently had a devastating impact on pine plantations throughout Virginia. More than 1,000 acres of newly planted pine were reported destroyed last year, while actual unreported amounts are likely to be much higher. Beginning in autumn, the risk of vole damage to newly planted pines increases substantially as grasses and other food sources become unavailable. This risk continues until green up the following spring. During very cold weather, damage can be worse as voles are forced to rely on the inner bark of small seedlings and saplings for their nutrition. The primary culprit appears to be the meadow vole (Microtus pennsylvanicus), whose burrows or runways can be seen along the ground surface. When snow accumulation occurs, vole damage can spread very quickly as the snow cover affords them protection from birds of prey and other predators. Pine voles (Microtus pinetorum) may also play a role in some of the destruction, particularly to the root system, but this is difficult to evaluate without trapping because their burrows run below ground. Small mounds of dirt are often seen at the burrow openings of pine voles; such burrows are about 1 inch in diameter and usually close to the base of a tree. Often, the only way to verify which species is present is through trapping.

While voles have been only an occasional problem in the past, rarely requiring intervention, their activity seems to have picked up dramatically. Many of our foresters with decades of experience have never had to confront this issue until now. Landowners from all over the Commonwealth have reportedly experienced complete plantation failures, some multiple times. Unfortunately, the 'conventional wisdom' for dealing with vole problems does not seem to apply in some circumstances. Right now there are many more questions than answers.

Here is what some of the conventional wisdom suggests:

1. Vole populations fluctuate dramatically from year to year and location to location. Usually, if you experience problems with them, you are just unlucky.

   Reality: More than a few landowners are experiencing problems every year. Some have replanted multiple times and have seen multiple failures.

2. The problem is not so widespread that it requires a substantial change in pine regeneration tactics.

   Reality: This is uncertain. It is happening in many locations, way too many to ignore.

3. Voles require substantial cover, usually heavy grass cover, to become a significant problem. Sod control or regular mowing in orchard settings generally keeps them under control.

   Reality: This is certainly true to a degree. However, some areas impacted have had what most would consider very low grass or weed cover.

4. Voles do not represent a threat to cut-over pine stands where herbicides are used regularly for weed control.

   Reality: Many vole-impacted stands have been cutover sites where traditional herbicide treatments have been implemented.

5. Voles feed on seedlings and young saplings, but once trees reach two inches or greater in diameter, they are safe.

   Reality: They will feed on much larger trees, some 3-4 inches in diameter in which every tree within a row is completely girdled. Some girdled trees are even larger. Sometimes the girdling is from the ground line to six inches or more off the ground. Many hardwoods are similarly affected.

"Man is the only animal that blushes, or needs to."

Mark Twain, 1897

Clearly there are many gaps in our knowledge about voles, and it is difficult to provide explanations for some of these observations without additional research. Foresters and landowners facing a new planting season need options now for dealing with this problem. Although there is little new information to offer, some past recommendations bear repeating.

Prior to establishing a new plantation, it is important to first determine whether there is an active vole population on site, and whether the population is serious enough to warrant delayed planting or active eradication prior to planting. A diligent monitoring program is essential to keep abreast of vole populations, which can fluctuate within and between years. This is primarily because meadow voles produce 5-10 litters per year, averaging five young per litter. Gestation is approximately 23 days, and females can mate again the same day that their young are born! Young are sexually mature within a month or two after birth. Pine voles produce fewer and smaller-sized litters, but have greater survival rates because they live underground and are better protected from predators. Therefore, even if vole populations are initially small or are killed back to low levels, they have the potential to become severe once again over a short period of time.

A relatively simple monitoring scheme can be performed using apple baiting. First, one has to carefully scout out where active vole burrows exist; look for the presence of vole droppings, fresh grass clippings or cached seeds within the runways. If rootlets, fine grass, or mold are growing within a runway, this suggests they may have been abandoned. Once areas of activity are delineated (pin flags or flagging would be helpful for this), establish a network of apple baits throughout the stand, at a density of at least one dozen stations per acre. At each station, place an apple with a one-inch slice or disk removed from it into the marked runway. It is very important to cover the apple with a shingle or tar paper to prevent other animals from finding the bait. After 24 hours, check each apple for tooth marks. Add up all the apple stations for which tooth marks are present and divide this number by the total number of stations to get the percentage of the stand or baited area that supports active populations. The percentage of apples that were fed upon can also be a rough gauge for what percent of trees in the stand could be damaged. Over 25% would indicate potentially serious damage and a need for vole management. If an entire apple is eaten, severe damage is likely in that location. Another measure that can be used is whether the amount of apple consumed is less than or greater than the size of the disk that was removed from the apple; if less, the population can be classified as slightly active; if more, highly active.

Once the decision has been made to control voles, the choice of control method includes physical barriers, vegetation management and chemical control. Physical barriers are impractical and too expensive for pine reforestation and will not be discussed.

Vegetation management should be vigorously pursued as it represents the only viable preventative measure in lieu of resorting to a rodenticide. Furthermore, rodenticide use is likely to be rendered ineffective without some vegetation management. Weed control is certainly not a guarantee of vole-free conditions, but it can help a great deal if implemented before vole populations begin causing damage. In preparation for replanting, a site prep prescribed burn can be effective at removing cover. However, the beneficial effects of a burn may be short lived; increased sun exposure and nutrient release after the burn may invigorate a dormant seed bank, creating a vigorous food supply for voles to quickly

"Whatever nature has in store for mankind, unpleasant as it may be, men must accept, for ignorance is never better than knowledge."

Enrico Fermi, 1955

recover. In this case, it may make sense to delay planting until this growth flush emerges so that it can be knocked back with an appropriate herbicide. Initiate planting soon after this herbicide treatment. Although, additional weeds will eventually reestablish themselves, this will buy the trees some time to grow and become more robust. Additional follow up herbicide treatments may be necessary. Reforesting old fields is considerably more difficult. Planted rows need to be as bare as possible through scalping or row application of an herbicide, with grass in between rows managed regularly through mowing or bush hogging. A prescribed burn can function to reduce cover, food sources, and accumulated organic matter; but this method is not often practical, safe, or allowable. Broadcast herbicides for control of herbaceous weeds, grasses, and forbs, where practical, will significantly reduce cover and food sources for voles. These treatments are costly and labor intensive, but not nearly as costly as losing the entire stand and having to replant. Monitoring vole populations through apple baiting may assist the landowner in making these critical management decisions. Even after all of this effort, trees that survive the first few growing seasons and put on a considerable amount of diameter growth may still occasionally succumb to voles.

As a last resort, use of a rodenticide is the only short-term option if devastation by voles is imminent. The most effective rodenticides are formulations of zinc phosphide impregnated into grain bait. These options include ZP® Rodent Bait AG or Prozap® oat bait. These are both restricted use pesticides and are available only to commercial applicators with a Category 2 (Forest Pest), 10 (Research and Demonstration) or 7D (Vertebrate Pest) license. In addition, those individuals with a private applicator license may purchase and apply these rodenticides to their own property, but cannot hire another licensed individual to do so. They may, however, have another licensed individual apply rodenticide to their own property as an exchange of services, provided no money changes hands for this service. If you take this route, READ THE LABEL VERY CAREFULLY. These baits are attractive and highly poisonous to other animals that consume them, and should be used with great care. Ideally, hand applying the grain directly to the burrow runs or around the base of the trees is the most effective way to target voles over other animals. However, this is not always practical if large acreages need to be treated. Another option is to fit a spreader onto either side of a tractor and apply the bait along the rows. Broadcasting is not recommended unless the acreage is very large and the vole populations severe. In this case, most of the bait is likely to be quickly consumed by voles rather than other wildlife. Rodenticides can be very effective at quickly eliminating a vole population. However, populations can resurge and become bait shy if this method is used more than once every few months or so. Thus, regular monitoring of populations is very important.

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