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Forest Management in the Interface: Forest Health[1]

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Initially forest health was limited to the recognition and management of destructive agents of forest trees, namely insects, diseases, and abiotic factors such as temperature and moisture extremes. Then the domain of forest health expanded, first to accommodate multiple-use management (timber, water, wildlife, and recreation) and subsequently to encompass the holistic concept of ecosystem management. Forest health issues grew from the health of individual trees to the well-being of the forest as a community of plants and animals, including humans. Currently, the domain of forest health includes aspects of traditional pest management (insects, diseases, and abiotic agents) but also includes consideration of plant and animal biodiversity, endangered species, invasive species, and aspects of restoration ecology.

Forest health is significantly influenced by people. Some problems are initiated, and others are exacerbated, by our activities. For example, the fungi that cause white pine blister rust and chestnut blight, the insects, gypsy moth and Asian long-horned beetle, and the invasive plants, kudzu and melaleuca were introduced into the forest ecosystem in the United States by people. Other problems caused by native flora or fauna, such as fusiform rust and southern pine beetle, have been spread and intensified by forest management practices or the lack thereof.

It is not so much that forest health issues are unique to the interface forest (although some are) but rather, it is the increased presence of people which influences forest health issues in interface forests. A premise of forest health management is that practices be biologically effective, environmentally safe, and economically feasible. The latter two conditions separate forest health issues in the interface forest from those in more extensive forest areas. Homeowners, out of necessity or desire to protect valued property, are willing to invest more money in interface forests than is feasible for the owners of extensive forests, public or private. In addition, environmental safety concerns are often greater in interface forests than in remote forest areas. Some forest health issues that can be ignored in extensive forest areas must be addressed in the interface forest. A few health issues, such as construction damage to trees and removal of severely damaged trees, are uniquely important in the interface forest.

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Not all forest health issues within the interface need to be dealt with directly, since many are a natural part of the forest ecosystem. Landowners' opinions and values vary with regard to how much damage is too much. For example, people who want cavity-nesting bird habitat will want a few old dead or dying trees and will not perceive this as a forest health problem. Some individual forest health problems are regional in occurrence or severity. Other problems only occur in specific ecosystems, i.e., pastures, flooded areas, or homesites, due to the effects of climate, soil type, or human influence on severity and spread. Only experience can provide a working list of potential problems and their solutions. Following are some potential important forest health issues in the southeastern United States with suggestions for their management.

Site Management

Proper site management can avoid several damaging forest health problems. Prevention is key since remedies are not feasible or are ineffective.

Construction damage. Perhaps the most frequent health hazard in the interface, especially around homesites, is that resulting from construction damage to the stems and roots. Trees severely wounded during the construction of building foundations, driveways, walks, and septic drain fields succumb to decay organisms in succeeding years. Wounds may not be obvious, especially those on the roots, and trees can appear healthy but perhaps five or more years later, declining crown symptoms become evident. Affected trees are a safety hazard and should be removed.

Toxic chemicals. Some chemicals used to control undergrowth and competing vegetation can be harmful to large trees. Severely affected trees have declining crowns and can eventually die. Not all chemicals used on lawns and transition zones around the home are tree-friendly and care should be taken by homeowners to read product labels carefully.

Species selection. Although many trees and shrubs have a wide tolerance for environmental conditions, care must still be taken in selecting the species most appropriate for the site. Some species grow well in understory shade while others require greater sunlight. In northern climes, frost hardiness is an important consideration. Still other plant species flourish with dormant periods. Drought tolerance is an important consideration, especially in the sandy soils of the Lower Coastal Plain, where plants without drought tolerance will grow poorly or die and must be irrigated frequently. Trees adversely affected by environmental conditions often fall prey to insect and disease problems. Trees resistant to insect and especially disease problems are available and should be planted in problem areas. Advice from nursery persons and others with the expertise or experience should be sought in choosing species and varieties to plant in interface areas.

Insects

There are many types of insects that inhabit forests and some cause significant damage to trees, especially trees in the interface. Most insect pests are effectively controlled by insecticide. However, these toxic chemicals, of which there are many on the market, have specific recommendations for use and instructions must be closely followed. Insecticides can be harmful to nontarget species, e.g., beneficial insects that prey on unwanted insect pests. No specific insecticide recommendations can be given here and expert advice is recommended both for professionals and homeowners when dealing with these toxic chemicals. Listed here are several of the most damaging insects categorized by their mode of attack.

Bark beetle and wood borers. Perhaps the most damaging of insects are those that bore into stems to feed and reproduce. Damage interferes with food and water transport in the stem and severely affected trees most often die. In recent years, explosive populations of the southern pine beetle have ravaged pines in forests, municipal areas, and homesites. Several other species of bark beetle attack and kill pines but most often only in isolated trees or in small patches. Bark beetle-affected trees can be recognized by the insects' small (pin-sized) entry and exit holes in the bark and the insect frass that accumulates around the holes. Bark beetle attacks are associated with mature or overly mature trees and dense stands of trees that have exceeded the carrying capacity of the site. However, once beetle populations have become

established and greatly increased, even healthy trees may be attacked and killed. Dense stands of pines are especially vulnerable to attack during periods of prolonged drought. Under these conditions, stand thinning is recommended. Felling and debarking newly attacked trees can impede expanding beetle populations and save nearby trees (See Figure 1).

Hardwood trees are also attacked by other species of bark beetle and wood borers. For example, small twig borers and larger wood borers are common on dogwood. Wood borers can be easily recognized by large (pencil-sized) holes in stems.

Figure 1. Southern pine beetles disperse widely and can cause extensive economic and ecological effects. Credits: Photo courtesy of USDA Forest Service.

Defoliating insects. Caterpillars, an insect larval stage, are among the most voracious leaf feeders. Large populations of caterpillars can defoliate small and even large trees in a few days or weeks. Repeated defoliation can result in the death of hardwoods, and pines can succumb to a single defoliation. Severe attacks weaken trees and predispose them to secondary pests, e.g., root decay fungi. Tent caterpillars are common on many hardwood species throughout the southeastern United States and are easily recognized by their tent-like webs in the tree crown. To the north, the gypsy moth has caused widespread damage to oaks and other hardwoods. Pine sawflies can defoliate their hosts, killing small trees.

Sap-feeding, sucking insects. Insects that feed on sap within leaves, stems, and branches can severely damage trees, especially conifers. Examples of the latter are the woolly adelgids that feed on fir and hemlock. These scale insects, recognized by their white cottony exterior body covering, are prevalent in the higher elevations of the southern Appalachians where they severely affect their host trees.

Chewing, girdling insects. Numerous insects feed on and girdle tree branches, especially hardwoods such as hickory species. These attacks are damaging but not usually lethal. However, weevils that attack the roots and root collar area of small, newly planted pines can result in the death of affected trees. The weevils live in the soil and litter around seedlings and are especially prevalent on sites with heavy sod. Removing the litter and sod around small seedlings destroys weevil habitat. It may also be helpful to delay planting in harvested areas until stumps, which can harbor weevils, have decayed.

Diseases

There are hundreds of microorganisms (e.g., fungi and bacteria) that live in association with plants. Most are saprophytes living on and decomposing dead organic matter and are beneficial to humans. Other microorganisms are parasites on living plants; some, especially fungi, cause significant damage to trees and shrubs. While chemical fungicides are effective against some fungal pathogens, other pathogens, those in stems and roots, are not easily controlled and are best prevented. As with insecticides, expert advice should be sought when choosing a fungicide and recommendations on the product label must be strictly followed. Listed here are several of the most damaging fungal diseases of trees in the interface forest.

Canker diseases. Fungi invade and kill stem and branch tissues, resulting in disfigured, swollen or sunken areas called cankers. Cankered trees can be killed outright or can die as a result of windthrow, breaking at the weakened stem. On southern pines, fusiform rust, easily identified by the disfigured, usually swollen cankers that exhibit orange reproductive spores of the fungus in the spring, and pitch canker which produces copious resin flow on stems and branches, cause significant damage. Fusiform rust is especially troublesome in interface areas since stem-affected trees are subject to windthrow and must be removed. Branch cankers should be pruned to prevent the spread into stems.

Varieties of pines resistant to fusiform rust have been developed and should be planted in high-rust-hazard areas with abundant red oak populations, the alternate host. Cankers on hardwoods are not infrequent and currently butternut canker and dogwood anthracnose are causing significant damage in the southern Appalachians. In this same area are two canker diseases of note: white pine blister rust and the infamous chestnut blight disease, which virtually eliminated American chestnut from the forest.

Tree decline. Some tree declines have complex causes involving climatic, soil, or biotic predisposing factors that weaken the trees to allow secondary opportunistic organisms to attack and kill affected trees. Primary and frequent predisposing factors are defoliating insects and drought. Secondary agents can be bark beetles and wood borers and stem- and root-decay fungi (see Figure 2). Declining trees exhibit crown dieback. Although severely affected trees typically die, less affected trees may recover if the predisposing factors do not persist. Decline may be viewed as a natural phenomenon: nature's way of removing overly mature and unhealthy trees, making room for young healthy trees. Oak decline occurs in southeastern forests and other hardwoods are also affected.

Figure 2. Wounds and disease can affect tree health. Credits: Photo courtesy of South Dakota University

Leaf diseases. Leaf diseases, often seen as discolored spots or irregular patches of dead tissue, can occur on all tree species. Most are not harmful and are a good example of a natural balance between trees and the many indigenous organisms that live in association with trees. Occasionally leaf diseases may become severe and lead to defoliation, and in such cases chemical control may be necessary, especially on young trees and ornamentals.

Abiotic Factors

Lightning strikes, drought, and flooding are the most frequent abiotic environmental factors that affect tree health. Lightning strikes appear as long vertical streaks of dead bark tissue, often running from tree top to roots. Some trees survive a lightning strike but most die soon after the occurrence. Trees may die or be predisposed to secondary organisms during long periods of insufficient rain. Long periods in saturated soils resulting from rain or unusual water levels can block soil drainage and adversely affect tree health. Other abiotic factors that damage trees are wind and temperature extremes, especially early fall or late spring frosts.

Invasive Plants and Animals

Invasive plants. Non-native or exotic plants invade forest ecosystems, often replacing and excluding native plants. Invasive plants can be especially predominant in interface forests when environmental conditions favor the exotic plants over native vegetation. More than 100 exotic plants occur in the southeastern United States, some of which cause severe problems. Examples of introduced plants growing out of control are kudzu (See Figure 3) and melaleuca; however, there are many others. Residents of the interface should learn to identify and discriminate against those plants that have the potential to adversely affect interface forests. Information is available from federal, state, and local agencies.

Invasive animals. Several non-native animals present challenges in interface forests. Armadillos have invaded from the southwestern United States and damage lawns in their quest for food. These grub- and insect-eaters are mostly nocturnal except during breeding and young-rearing periods. Live trapping is one method of controlling armadillo populations. Another invasive animal moving eastward is the coyote. This top predator feeds on small mammals but

Figure 3. Kudzu (*Pueraria montana*) is an invasive plant that is common in many parts of the southeastern United States. Credits: Photo by: Larry Korhnak

can kill larger wildlife species, such as turkeys and fawns. Unfortunately, house pets, especially cats, are easy prey for foraging coyotes. Other nuisance and sometimes destructive animals in the interface include native animals, such as raccoons, opossums, and squirrels. The white-tailed deer has become a severe problem in many places as deer herds have increased greatly. Deer feed on vegetation including ornamental plants in residential areas and have become a severe road hazard in interface areas. On occasion, black bears present a nuisance problem, particularly for owners of bee hives. Of course, dwellers in the interface forests must be vigilant for poisonous snakes, of which the diamondback rattler, cottonmouth, coral, and copperhead occur in specific habitats in the southern United States. Populations of native animals may be evidence of healthy forests, but the public may perceive them as problems. Convincing interface dwellers of the value of nuisance wildlife is a challenge.

Domesticated cats and dogs have become nuisance feral animals in the interface. Feral cats in particular have increased greatly in some interface areas. These efficient predators prey on small mammals and on birds. Live trapping can help to reduce the feral cat problems.

Summary

Forest health concerns in the wildland-urban interface include slightly different issues and quite different management solutions than the same concerns in rural forests. The presence of homes and the increase in landowners may make some management options unavailable, such as aerial spraying, and may bring new problems, such as non-native species. Careful attention to the values that landowners hold about their trees and the perceptions they have about forest health will assist natural resource professionals who work in this area.