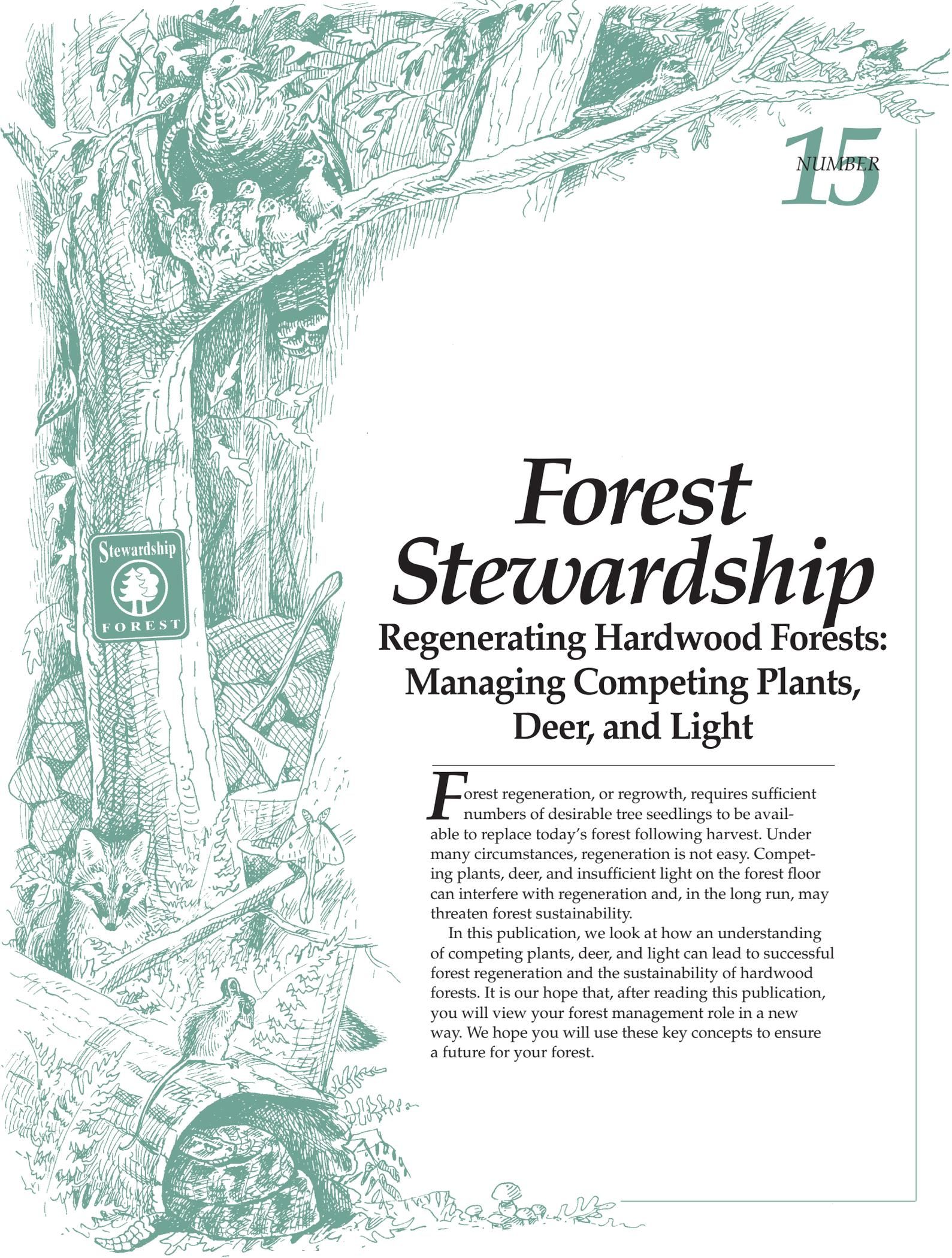


Forest Stewardship

Regenerating Hardwood Forests: Managing Competing Plants, Deer, and Light

Forest regeneration, or regrowth, requires sufficient numbers of desirable tree seedlings to be available to replace today's forest following harvest. Under many circumstances, regeneration is not easy. Competing plants, deer, and insufficient light on the forest floor can interfere with regeneration and, in the long run, may threaten forest sustainability.

In this publication, we look at how an understanding of competing plants, deer, and light can lead to successful forest regeneration and the sustainability of hardwood forests. It is our hope that, after reading this publication, you will view your forest management role in a new way. We hope you will use these key concepts to ensure a future for your forest.



How do we benefit from a healthy forest?

We all benefit from a healthy, productive, viable forest. To name a few of the benefits:

- Forests clean our air by using carbon dioxide and providing oxygen.
- Forests protect and filter our water supplies.
- Forests provide a home for countless plants and animals.
- Forests make up a vital part of the economy.
- Forests are a major source of employment.
- Forests supply the key ingredients for more than 5,000 products.



PHOTO: HOWARD NUERNBERGER

As forests mature and people begin to conduct harvests, potential regeneration problems need to be identified. This mature forest clearly lacks regeneration.

Forests are a precious natural resource

We depend on forests for the quality of life we enjoy. We *use* our forests to sustain life as we know it. Wisdom tells us that future generations, your children and theirs, will also use our forests for these same benefits. The science of forestry was developed to “sustain” our forests. Currently, with a maturing forest and increased harvest levels, “sustainable forestry” has become a necessary label. While many claim to practice forestry, few do so in a sustainable manner. The problem lies not in forest science but in its rampant misuse in name and practice.

SUSTAINABLE FORESTRY is defined as managing our forest resources to meet the needs of the present without compromising the ability of future generations to meet their own needs.

How are we doing?

A comprehensive study in 1995 examined 85 randomly selected timber harvest sites in Pennsylvania. The study sought to determine if our current harvesting practices are affecting timber sustainability. *It found that 47 percent of the harvests were unsustainable.*

What was wrong with these timber harvests? The concerns most often identified were

- failure to retain quality trees of desirable species;
- failure to establish adequate regeneration; and
- failure to remove sufficient overstory to foster existing regeneration development.

Two of these concerns deal with problems in *regenerating* (or regrowing) our forests; harvests are occurring without adequate plans for tree replacement. Sustainable forestry requires that we focus on growing new trees, but we cannot practice sustainable forestry if we do not regenerate a healthy, young forest for future generations.

Recent U.S. Forest Service data from Pennsylvania’s statewide forest inventory (2004) document regeneration problems. In forest stands where light conditions are adequate for

regeneration development, less than 50 percent have adequate seedlings and saplings to regenerate the forest. This finding includes all tree species capable of growing into the forest canopy. When only commercially desirable species are considered, less than one-third of these forest stands have adequate regeneration to replace the existing forest.

Many times, forest owners believe that by harvesting forests “selectively” they are addressing regeneration issues. This is not normally the case. The remaining trees often create too much shade, are of too low a quality, or are a less desirable species to warrant having been left for future harvests. Regenerating a forest is a process, not an event. That is, harvesting does not always lead to successful regeneration—it takes planning, care, and investment to ensure an adequately stocked forest for the future.

“For decades, it has been obvious that there have been difficulties in achieving successful regeneration of fully stocked stands across Pennsylvania.”

—Dr. James C. Finley,
The Pennsylvania State University

What can you do?

The challenge for each landowner is to continue using our forest resources without jeopardizing resource health or future. Landowners, loggers, and foresters all play key roles in achieving a successful timber harvest outcome. Each group has equal responsibility for creating healthy forests in the future.

“The predominant challenge for sustainable forestry in Pennsylvania is prompt reforestation with desirable species.”

—Dr. Susan Stout,
USDA Forest Service

Combating the regeneration issue

Most regeneration of hardwood forests occurs naturally, that is, without trees being planted; but many factors can affect forest regeneration. To regenerate naturally, the current forest must produce seedlings, stump sprouts, and root suckers that will become the next forest following a harvest. The right conditions are necessary for forests to regenerate naturally. Unfortunately, the “right conditions” often are not met.

In this section we will look at three factors affecting forest regeneration and introduce practices to help make timber harvests sustainable. The three factors are *competing vegetation*, *deer impact*, and *light on the forest floor*. We abbreviate this as C-D-L. Following the practices outlined by this simple acronym will encourage healthy, new forests following timber harvests.

COMPETING VEGETATION

Competing vegetation consists of plants that interfere with the germination and growth of desirable seedlings by casting dense shade across the forest floor. Some competing plants also provide cover for small mammals that feed on tree seeds.

Several factors favor the development of competing vegetation. Many interfering plants tolerate shady understory conditions and are not typically browsed by deer. Some, such as Japanese barberry, are also *invasive*, meaning that they spread rapidly and suppress native plant communities. Competing plants are similar to weeds in your garden—they interfere with the establishment and growth of your future crop.

The most common competing plants found in Pennsylvania include hayscented and New York ferns,

some grasses, striped maple, American beech, mountain laurel, ironwood, and musclewood. Many other plants can interfere with seedling growth and development too. There is only so much space, water, nutrient material, and sunlight available for plant growth. Whether you are growing corn, grass, or trees, you must make choices about resource use. Undesirable trees and plants can take over a forest just as weeds can take over a garden.

Competing vegetation can prevent diverse and valuable forest regenera-



PHOTO: HOWARD NUERNBERGER

This area has severe interfering fern cover. Desirable regeneration is not likely to develop until the ferns are controlled.



PHOTO: HOWARD NUERNBERGER

Hand application of herbicides are appropriate for small areas or when treating individual invasive or competing plants.



PHOTO: HOWARD NUERNBERGER

When competing plants cover extensive areas, herbicide treatments using track-mounted mist blowers are most effective when applied prior to harvesting timber.

tion as well as the establishment of desirable nonwoody plants, such as native wildflowers, forbs, and herbs. If competing plants are present and left untreated in an area that you propose to harvest, they may become your next crop. Timber harvesting will increase light on the forest floor and magnify the problems caused by competing plants. It is not uncommon in Pennsylvania to see forest understories filled with competing plants.

Often, successful forest regeneration depends on controlling competing vegetation. Extensive research and testing have provided low-risk and effective herbicide recommendations or “prescriptions” for controlling most competing vegetation. Public and private forestry organizations across the state have experience with herbicide use for this purpose. Consult them for detailed prescriptions for dealing with your specific competing vegetation problem.

If you are reluctant to use herbicides, mechanical removal of competing vegetation may work in some cases. Typically, mechanical methods such as cutting or pulling are not as effective as chemicals and are ineffective at controlling nonwoody plants like fern and grass. Mechanical removal generally involves having the harvesting operator break off or cut competing seedlings and saplings. With this method, the competing plants will likely resprout; however, they may no longer have a height advantage over desirable seedlings.

To sustain our forests, competing vegetation problems need to be recognized and treated before harvesting timber. Dealing with competing vegetation before harvest is important because, after harvest,

- logging slash can impede access;
- increased light may cause competing plants to flourish;
- desirable species may be more easily harmed by herbicide treatments; and
- costs for controlling competing plants are typically higher.

DEER IMPACT

Through selective feeding, deer have the ability to broadly affect forest plant communities. Specifically, they can reduce tree seedling numbers, seed availability, species composition, and seedling height. They can also affect herbaceous plant composition as they browse on some species and ignore others.

In many areas, deer have reduced seedling numbers, shifted tree species composition to less desirable species, and slowed the growth of surviving seedlings. Research has shown that when the deer population density exceeds what the land can support, forest regeneration suffers. In regions of the state where decades of overbrowsing have severely depleted the habitat, even relatively few deer can have significant effects.



PHOTO: TODD HAGENBLUCH

Forest regeneration inside versus outside a fence. Research demonstrates that high deer impact inhibits forest regeneration.

In many parts of Pennsylvania, deer numbers have adversely affected habitat. In fact, many state residents have never seen a healthy forest understory unaffected by deer. Habitat repeatedly damaged by overbrowsing continues to decline, losing its ability to support additional deer. In many areas, poor habitat conditions limit deer numbers more than hunting does. The only way to increase the number of deer land can support is to temporarily reduce deer numbers still further and allow the habitat to recover. When the habitat improves, deer managers can gradually allow deer numbers to increase until a balance is reached between desired habitat conditions and deer populations.

Deer have taste preferences; they really like some plant species and hardly touch others. By selectively browsing preferred species, deer have the ability to completely change the species found in the forest understory. Selective browsing can greatly reduce or eliminate preferred species or those not resilient to browsing. Obviously, this selective feeding favors less preferred, more resilient species. Deer food preferences vary by region and season, but, in general, deer prefer oak, maple, ash, and yellow poplar over species such as beech, birch, and cherry. Deer, on average, consume four to eight pounds of

browse per day for seven months of the year. Clearly, the state's deer herd has a tremendous potential to influence what grows (or doesn't grow) in the forest.

Landowners can use several indicators to assess whether deer impact in their forest is high or low. Indicators of high deer impact include severely browsed or hedged seedlings, obvious browse lines, and forest floors dominated by species that deer do not prefer or species that are resilient to browsing. Deer do not readily eat ferns, striped maple, beech, ironwood, mountain laurel, blueberry, or spicebush.

"Attempting to raise more deer than the land can support has been the greatest mistake in the history of wildlife management in Pennsylvania."

—Dr. Gary Alt, Pennsylvania Game Commission, retired

There is strong evidence that the expansion of understory fern in forests across Pennsylvania results from deer overbrowsing, which removes plants that would normally compete with ferns. Forests with a dense fern carpet are the result of high deer impact over many years. Research has

shown that fern density increases as deer impact increases. Unfortunately, after fern cover dominates the understory, the forest's ability to support deer declines. A severely damaged forest may appear to have no deer at all. Likely, a few deer will continue to suppress desirable tree species. The cycle of browsing and poor habitat is continuous and difficult to break.

If you recognize that deer impact on your forest is high, you should take steps to reduce populations even if a timber harvest is not planned for the immediate future. Consider harvesting additional antlerless deer. The Pennsylvania Game Commission's Deer Management Assistance Program (DMAP) helps landowners meet their forest management goals. DMAP allows hunters to harvest additional antlerless deer from a property during the regular hunting seasons.

Although hunting is by far the most practical means of reducing deer impact, other tools include fencing, seedling protectors, and deer repellants. Areas with low deer impact will support healthy, diverse understories, preparing the forest for future replacement following planned timber harvests or natural disturbances.



PHOTO: DAVID JACKSON

← **Note the "browse line," where deer have eaten the preferred palatable vegetation from ground level to a height of five feet. Browse lines are an indication of high deer impact.**

LIGHT ON THE FOREST FLOOR

The amount of sunlight reaching the forest floor plays a key role in determining which species of tree seedlings will germinate and grow. Tree species have different requirements for sunlight, a factor referred to as shade tolerance. Shade tolerance describes the light level at which a species is best able to germinate and grow. Foresters generally separate trees into three shade tolerance classes: intolerant, intermediate, and tolerant.

Examining the shade tolerance classes of three valuable timber species, we find they fall into three different shade tolerance classes: black cherry, intolerant; northern red oak, intermediate; and sugar maple, tolerant (see Table 1). Understanding the shade tolerance characteristics of desirable species forms the basis for developing harvest prescriptions.

For example, if a forest is managed for shade intolerants and intermediates such as yellow poplar, white ash, black cherry, and oak, you have to increase the amount of light across the forest floor to stimulate seed germination and seedling growth. Harvesting activities *must* consider shade tolerances of the species for which you are managing.

Table 1. Shade tolerance for common Pennsylvania trees.

SPECIES	SHADE TOLERANCE
Black cherry	Intolerant
White ash	Intolerant
Hickory	Intolerant
Yellow poplar	Intolerant
Northern red oak	Intermediate
White oak	Intermediate
Basswood	Tolerant
Red maple	Tolerant
Sugar maple	Very tolerant
American beech	Very tolerant

Foresters have developed harvesting systems that create openings that mimic natural disturbance. These systems regenerate diverse, healthy forests. Harvesting systems used in Pennsylvania to create light conditions for shade-intolerant and intermediate species include group selection, shelterwood, seed tree, and clearcutting.

Group selection cuts create small openings across a forest with the intent of establishing regeneration in each opening. This method harvests all trees larger than two inches in diameter in groups ranging in size from one to four acres scattered across a property. Openings less than one acre will not provide adequate sunlight for shade-intolerant tree species. By scheduling group selection harvests at 10- to 20-year intervals, landowners can produce periodic income and encourage habitat diversity. This harvesting system is desirable for aesthetic reasons since it retains areas of large, mature trees and the openings created are relatively small. The harvested groups are large enough to encourage the regeneration of shade-intolerant tree species in the center and more shade-tolerant tree species along the edges.

Shelterwood and seed tree cuts occur in two stages. The first stage leaves a prescribed number of desirable trees per acre to drop seed and provide conditions (partial shade, cooler temperatures, and higher moisture) conducive for seedling development. The residual trees provide an environment best for intolerant and intermediate tree seedling growth and development. Once regeneration is well established, the remaining overstory trees are harvested and the new forest grows in full sunlight. The timing of the final harvest is critical. The regeneration should be tall enough (greater than 5 feet) to be above the deer's reach but not so large (greater than 10 feet) as to be significantly damaged during final harvest when remaining overstory trees are removed.

Clearcutting should be practiced only where adequate forest regeneration is already present on the forest floor. This is called advanced regeneration. The next forest is already in place and simply needs more light. In areas with high deer impact, adequate advanced regeneration is difficult to achieve. It is necessary to have at least one desirable seedling per square foot (40,000 desirable seedlings per acre or more).

What are the costs?

Managing C-D-L certainly involves investments of thought, money, and time. However, it is necessary to *address all three components* when planning a sustainable harvest. In most cases, failing to make the necessary investment for managing the interactions of competing vegetation, deer, and light will lead to inadequate desirable regeneration after a timber harvest. Regeneration failures, on a large scale, would devastate our forests and threaten many of the benefits we depend on every day.

When we discuss the costs of C-D-L and other efforts that help sustain our forests, we have to consider the costs of *not* using sustainable methods. Treating competing vegetation, managing deer impacts, and meticulously controlling light can be costly, but how does that compare to the degradation or loss of our forests' vitality?

If you control competing vegetation, reduce deer impacts, and take into consideration the light requirements of the species you are trying to regenerate, you will be successful in establishing and sustaining new forests.

Putting it into practice

C-D-L practices have become central to managing our public forests. Deer exclosures are common in state and national forests as well as state game lands. Herbicide treatments, clearcuts, shelterwoods, and other forest management practices that address C-D-L are also common. Unfortunately, the sustainable forest management practices used by public agencies are not occurring in many private forests. This is cause for concern.

Pennsylvania has vast forest resources—17 million acres. The amount of public forestland is actually small compared to the amount of forestland owned by private citizens (see Figure 1). Every day, private forest landowners make decisions that affect future forest values. Critical among these decisions is the need to ensure that we are regenerating hardwood forests. The 1995 Pennsylvania study revealing that 47 percent of private forest harvests are not sustainable is a benchmark for the future. If forest owners manage forest resources to meet today's needs without interfering with the needs of future generations, all harvest sites will be sustainable. In this way, we will

- retain quality trees of desirable species;
- establish adequate regeneration; and
- remove sufficient overstory to foster existing regeneration development.

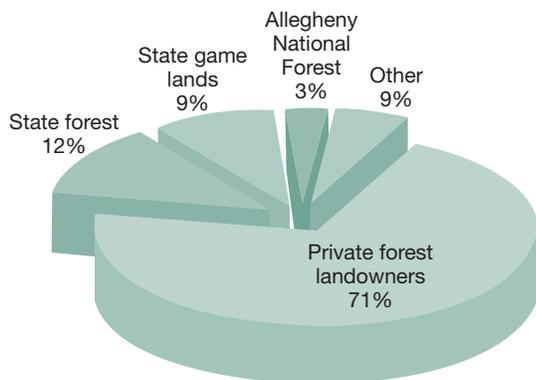


PHOTO: MIKE WOLF

A sustainably managed forest. The competing vegetation on this site was treated with an herbicide before harvest. Immediately following harvest, the deer fence was erected. This shelterwood harvest left a good seed source and allowed the proper amount of light to reach the forest floor. Within a few years, a healthy, new forest will regenerate on this site and a subsequent harvest will remove the overstory trees.

Because of our dependence on forest products for the quality of life we enjoy, we will continue to use our forests and harvesting in Pennsylvania's private forests will likely continue. It is vital that every timber harvest proceed with the advice of a professional forester and be part of an overall forest management plan. The plan will provide custom guidelines to follow, guidelines that will certainly address C-D-L and other sustainable forestry considerations. Remember to plan! Remember to invest! Remember C-D-L! *Regenerate hardwood forests.*

Figure 1. Pennsylvania forestland ownership chart.



Source: DCNR Bureau of Forestry

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