Penn State **Extension**

AGRICULTURAL ALTERNATIVES

Managing Small Woodlots

As a woodlot owner, you may have thought from time to time about your lot's future and what you might do to improve its condition and value. Most Pennsylvania woodlot owners use their lots for recreation, a place to hunt, or something to pass on to the next generation. Sometimes, though, woodlot owners want or need to harvest some timber from their woods. This is the time when you can improve your woods for the future or cause real damage from which it might not recover for generations.

This publication will help you understand how our forests grow, provide steps to planning for their management, and describe how to sell and market trees. You should carefully consider your decisions and seek assistance from a professional forester who can represent your interests in the selling and harvesting process. The investments you make at this point will pay great dividends in the future health and value of your woodlot.

Pennsylvania's Forests Today

Forests cover more than 17 million acres in Pennsylvania, representing about 60 percent of the state's land area. Private landowners own about 70 percent of the forests (12 million acres). County, state, and federal governments control much of the remaining forests (4.5 million acres, 23 percent). The forest products industry—once a significant landowner—now holds less than one million acres of Pennsylvania's forests. Now, timber investment management organizations (TIMOs) and real estate investment trusts (REITs) own and manage the larger privately owned forest tracts in the state.

Forests are important to Pennsylvania's economy. The forest product industry is the fourth largest manufacturing segment in the state, employing nearly 90,000 people and contributing more than $15 billion to the economy annually. The Commonwealth is the nation's largest producer of hardwood lumber at over one billion board feet every year. Forests are also the source of millions of days of outdoor recreation that contribute an additional $10–12 billion to the state's economy. Beyond their economic benefits, forests contribute to our quality of life by providing clean air and water, aesthetic views, stormwater control, and wildlife habitat.

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Because private forests are a dominant land ownership class, it is clear that the decisions made by the estimated 600,000 private owners of one or more acres have a major impact on the economic, social, and ecological health of the state. Over time, as forest ownership has changed, most of these sales have tended to break holdings into increasingly small parcels. This process, now called parcelization, is another major threat to many of the values we associate with forests.

Forest History and Current Condition

Timber production has been a part of Pennsylvania's economic history since the first Europeans arrived, with the first sawmill established by Swedish settlers in Philadelphia in 1662. When Pennsylvania was given to William Penn by Charles II of England in 1681, about 90 percent of the province was covered by forests. At that time, Penn recommended that "care be taken to leave one acre of trees for every five acres cleared." During the next 200 years large tracts of land were cleared to produce charcoal for the iron industry and provide land for farms.

At the peak of land clearing in the 1890s, about two-thirds of the state was cleared. From the late 1880s through the 1920s, forest clearing provided essential farmland and met the nation's appetite for wood. During this period of forest exploitation, the area of forestland was reduced to less than 11 million acres. At the end of this period, forest-dependent industries such as leather tanning, wood chemical manufacturing, charcoaling, and sawmilling collapsed and economic conditions led to farmland abandonment. The forests then began the slow process of recovery.

Today our state's hardwood forests contain world-class oak, maple, and cherry. Gone are the extensive forests of white pine, hemlock, and American chestnut, which were either harvested or taken by blight. Forest inventories conducted by the U.S. Forest Service suggest that we have more tree volume growing in the state today than we have had in more than 100 years.

However, not all is good in the forest. Data suggest that about half of the forests in the state are in poor condition, unable to regenerate with desirable tree species. Insects, diseases, and harvesting practices are driving tree species composition change. Less desirable tree species such as red maple, black birch, and black gum are more common. All of our oak species are much less common. Invasive exotic plants such as multiflora rose, bush honeysuckle, ailanthus (aka, tree of heaven), autumn olive, and garlic mustard are severe competitors with native trees and plants. Competing native plants such as ferns, spicebush, and mountain laurel are also increasing in forest understories. Poorly conceived harvesting practices, known as selective cutting and diameter limit cutting, are shifting overstory species composition, removing desirable seed sources, leaving poorer quality trees, and generally reducing forest economic and ecological values. Use of carefully applied science-based forestry practices is needed to restore forest health and provide future value to those landowners who will own and manage our forests tomorrow.

Managing Your Small Woodlot

The most important thing to consider as a woodlot owner is how you value your woodlot. Specifically, how do you currently use your woodlot, what do you value most (recreation, income potential, etc.), and what would you like to have for retirement or the next generation?

First, consider this question: How do you use your woodlot? Many people think about their forests primarily as recreational resources. Woodlots are a place to hunt, walk, or get away. You may also consider it part of your legacy, something to pass on to the next generation. When asked to rank the values they attach to forest, few people rank timber or the economic value of forested land as very important. A Penn State study conducted in 2006 asked landowners about the economic value of their woodlot. Unexpectedly, they had a reasonable idea of the value of the timber, but they were less well informed about the best way to manage their property for multiple uses. Landowners often find that woodlots have already been picked over, are in poor condition, and were unlikely to continue to pay reliable dividends without some care.

So, what do you value? Do you want to cash in on your trees from time to time? This can actually increase your woodlot's future value if it is done with attention to sustainability and proper forest management practices. Do you value hunting, seeing the big buck, or taking a turkey? Cutting timber will affect wildlife habitat, food sources, and possibly access to water. It is important to carefully think about your objectives and consider how decisions to manage your woodlot might change the things you value.

The Dynamic Forest

Forests change on their own every day in small and cumulative ways. Eventually, you become aware of these changes. A basic understanding of forest processes depends on a study of ecology. This helps us understand how forests change and how management decisions affect forest values.

Trees and all plants require certain amounts of water, nutrients, light, and space to grow. Every tree requires space to ensure that it can capture enough light, water, and nutrients. Forest management involves controlling the space around your trees so they can retain or increase their leaf surface and grow. Without proper management, "decisions" about how trees compete for growth resources are left entirely to natural competition.

Management Planning

To increase the value of your woodlot, careful planning is required. Writing a management plan will help you consider what you value about your woods and what you hope to achieve, and provides a schedule of activities to achieve your vision. Many woodland owners find they benefit from involving their family in these discussions and working with a forester who can translate their objectives into actions. The management plan should involve everyone concerned with the current operation and take into account future generations. If you plan to sell timber, a professional forester who understands your vision and works for you will ensure you market your wood well and conserve your woodland values. Many studies have concluded that professional foresters representing the seller are involved in less than one-fifth of timber sales.

Steps of the Management Plan

1. Determine both your short- and long-term objectives. What do you want from this woodland?
2. Assess the physical and biological characteristics of your woodland. Can this land meet your objectives? If not, what options do you have?
3. Develop a written management plan, which should include a time table for meeting your objectives.
4. Follow the management plan to ensure that you achieve your objectives.

Evaluating Your Woodlot

Before any marketing activities take place, you should be certain about your property boundaries. An accurate survey may be necessary. Your deed contains a written description of your boundary corners and is available from your county courthouse. An aerial photograph from your local Farm Service Agency office with the property boundaries is also helpful. A topographical map is useful for showing elevation changes, streams, and other landmarks. A soils map from your local extension office or conservation district will provide information for determining what tree species may be on your property.

There are two primary forest types in Pennsylvania: (1) oak/hickory (about 47 percent of forested land) and (2) northern hardwoods (about 40 percent of forested land). The oak/hickory type on deep, fertile soils includes red, black, and white oaks. Poorer sites in this type will also include chestnut oak. Red maple, black birch, hickory, ash, black gum, and white pine are also common in these woodlands. The northern hardwoods forest type is commonly associated with the Allegheny Plateau and with lower and northern-facing slopes in the central parts of the state. Tree species include sugar maple, beech, yellow birch, black cherry, ash, yellow poplar, and red maple.

Tree species, quality, board foot volume, and logging "chance" all contribute to the value of trees in your woodlot. Quality has a major impact on the income you will get from your woodlot and is determined by log form and length, presence of surface and internal defects, growing site (soil types), and location. Logically, proximity to mills and markets should affect price; however, if you have enough volume of high-quality logs, this is less of a problem.

Logging chance involves a lot of considerations. Site conditions—such as well-drained soils, for example—will permit logging during wet periods. Very steep areas that make road building or log skidding difficult will lower prices offered, as will flat sites with poor drainage. Proximity to water and stream crossings can increase logging costs. The volume of trees per acre, the shape of the sale area, distance to roads, time of year, owner-imposed restrictions on cutting, equipment needs, and myriad other factors all affect the price offered.

Saw and veneer logs are bought and sold on their board foot volume and grade. Three log rules are used in Pennsylvania for measuring the number of board feet in a tree: the International, Scribner, and Doyle. You should always know which log rule a buyer is using to ensure that you understand the price offered. As shown in Table 1, the volume estimate for smaller logs varies considerably depending on the log rule used. When the trees are about 20 inches in diameter at breast height (DBH; approximately 4.5 feet), the rules come together somewhat but still give different estimates.

Table 1. Comparison of board foot estimates from commonly used log rules for 16-foot logs in standing trees.*

	LOG RULE		
TREE DBH (INCHES)	INTERNATIONAL	SCRIBNER (BOARD FEET)	DOYLE
12	56	47	29
14	78	69	48
16	106	95	72
18	136	123	100
20	171	157	135
22	211	194	174
24	251	234	216
26	299	281	266
28	347	327	317
30	403	382	376

*Form Class 78.

Source: Daniel Cassens, "Log and Tree Scaling Techniques" (West Lafayette: Purdue University Cooperative Extension, 2001), www.extension.purdue.edu/extmedia/FNR/FNR-191.pdf.

Timber Marketing

If your management plan includes selling timber, approach the market thoughtfully. Selling timber is often a once-in-a-lifetime event that will have long-term impacts on your forests and what it provides to you and your family today and tomorrow. A good source of regional price information based on recent sales is the *Pennsylvania Timber Market Report,* which is produced quarterly. It is available from your local extension office or online at **extension.psu.edu /timber-market-report.** To help ensure the best possible outcome, take into account both price and forest health and productivity, and consider hiring a professional forester to work on your behalf.

Consulting foresters will charge a fee, which may be on a lump-sum basis, a percentage of the sale price, an hourly rate, or on units of work completed. Your consulting forester will mark the trees to be cut, determine the value of the marked trees, assist with the bid process, and inspect the woodland during the logging process. Fees charged by your consultant are an expense of sale and you can deduct them from the gross income, reducing your tax liability. To learn more about this, visit National Timber Tax Website **(www.timbertax.org).**

Your professional forester has two primary obligations: (1) to help you get the best return from your timber and (2) to leave the best possible residual forest to protect your management options. To do this, your forester will:

1. Negotiate a contract with you covering his/her responsibilities in preparing and administering the timber sale
2. Determine the volume, quality, and approximate value of the standing timber
3. Devise a plan to control the harvest procedure
4. Develop an erosion and sedimentation plan
5. Notify potential buyers of the impending sale and solicit bids
6. Collect and hold any completion bonds
7. Negotiate a contract on your behalf and keep your management plan in mind
8. Inspect the harvest operation frequently
9. Conduct a postharvest follow-up before closing the contract and releasing the bond

In preparation for a timber sale, your forester will prepare the documents used to solicit bids from potential buyers. He or she will also know which buyers are reputable and help you find the best possible price and harvesting outcome that protects your future investments.

You should also consult with your legal counsel during the contracting process when selling timber. Have your lawyer review the contract when you hire your forester and the resulting contract for the timber sale. These added steps may save you time and money in the future. Contracts should include all the details relating to the sale, logging, and any follow-up work the buyer is responsible for before closing the operation.

Table 2. Minimum size requirements for hardwood log grades.

LOG GRADE	LOG DIAMETER AT BREAST HEIGHT (AT 4.5 FEET)	LOG DIAMETER TOP OF BUTT LOG (AT 17 FEET)
Grade 3	12	9
Grade 2	14	11
Grade 1	16	13
Veneer	18	15

After the logging and follow-up are complete, inspect the woodlot with your forester to determine that all agreements have been fulfilled. Are there any roads to grade? Are there any places requiring stabilization to prevent erosion? Did the loggers remove any unmarked trees? All such questions need to be answered prior to the final settlement of the contract.

Sawtimber

Selling sawtimber, including veneer, provides the best economic return from your woods. The market for sawlogs has been quite volatile in recent years with changing economic conditions. Knowing exactly what you want to sell should be an essential part of a marketing plan. Your forester will help you in this process by reviewing your management plan and understanding how you wish to manage your woodlot. The forester will measure and mark trees for removal. As a rule of thumb you will need between 20,000 and 50,000 board feet of lumber to attract qualified buyers.

Marketable sawtimber trees will measure at least 12 inches DBH and have at least one 16-foot log before any major branching of limbs. In the marking process, trees to be cut should be marked at DBH and below the stump. Doing this ensures that the correct trees were harvested.

The quality of your timber or logs has a dramatic impact on the income you can realize from the sale. Log grades directly relate to lumber grades and greatly influence the price you will receive. Generally accepted log grades are grade 3 (low quality), grade 2 (medium quality), grade 1 (high quality), and veneer (the highest quality). Lumber grades project the yield of clear (knot free) boards of specific sizes. Several factors affecting the log or lumber grade are log straightness, size (see Table 2), and spacing of defects such as holes, knots, and splits. The grading rules for veneer are very specific. Veneer logs must be at least 18 inches DBH with no exterior defects. Red oak, white oak, and black cherry are our primary veneer species. Markets for veneer are seasonal and vary by location.

Pulpwood

Pennsylvania has markets for hardwood and softwood trees for pulp. Most pulpwood comes from trees between 4 and 12 inches DBH with a maximum of 20 inches DBH. Pulpwood harvesting is usually part of an integrated sale, which also involves sawtimber cutting. A well-planned, integrated sale

will focus on leaving the best growing and most desirable trees and removing their competitors. The amount of wood removed in a typical pulpwood sale might be 15–30 tons per acre, with hardwoods selling for $1.50–3.00 per ton and softwoods for $3.00–6.00 per ton. Clearly, the income generated from pulpwood harvesting is not large; but, if done correctly it can greatly improve forest health and growth.

Fuelwood

Fuelwood or firewood cutting is one of the lowest value crops you can take from your woods. Done carefully and as part of a thinning operation where cutting provides more crowning space for the remaining trees, it will improve your woodlot. You may sell wood on the stump or deliver it to the consumer as cut and split. Selling firewood on the stump involves the least amount of effort, but it also yields the lowest income. If you do not have experience felling, skidding, and processing trees, this is the safest option. In Pennsylvania, firewood must be sold by the cord (or fraction of a cord), which is a stack of wood 4 by 4 by 8 feet (approximately 128 cubic feet). Firewood on the stump may sell for between $10 and $25 per cord, depending on species and your location. If you have not previously removed wood from your woodlot, the first thinning may yield 3–8 cords per acre.

If you choose to cut, split, haul, and stack the firewood, you will need the proper equipment. This equipment may include a chainsaw, safety equipment (i.e., safety chaps, helmet, face shield, ear protection, and safety shoes), wedges, a splitting maul or mechanical splitter, and a pickup or trailer. A cord of wood split, delivered, and stacked may sell for $100–200 (and sometimes more) depending on species, location, alternative energy prices, and demand.

Silviculture Practices

Silviculture is the theory (science) and practice (art) of controlling forest establishment, composition, structure, and growth. Establishment involves either planting or naturally regenerating the next tree crop. Composition involves matching the tree species to site and management objectives. Structure reflects the arrangement of the trees in and below the canopy in a woodlot. Growth addresses how individual trees and all trees receive site resources (i.e., light, moisture, and nutrients). A forester who understands your management objectives will use silvicultural practices to design and implement a plan to meet your short- and long-term goals.

Silviculture treatments promote the growth of the most desirable tree species. This normally requires cutting trees that are competing for light and space with the trees you want to grow. Allowing nature to "decide" which trees to remove will not necessarily result in a healthy or productive woodlot.

Because of the history of cutting in Pennsylvania, many of our woodlots contain trees that are roughly the same age. That means that the trees comprising the upper canopy all started at about the same time. This is often a difficult concept to grasp as the individual tree diameters vary greatly in any given woodlot. Relatively few truly mixed-age stands in Pennsylvania have three or more age classes comprising the stand. In even-aged woods, intermediate cutting is the primary silvicultural tool for improving the woodlot. Intermediate cutting removes the least desirable trees and allows room for the more desirable trees to reach their full potential.

Table 3. Distribution of trees by diameter class before and after an improvement cut in a 70-year-old, even-aged oak/hickory stand.

DBH CLASS (INCHES)	TREES PER ACRE		
	BEFORE CUT	AFTER CUT	TREES CUT
4	12	12	0
6	24	8	16
8	12	2	10
10	24	10	14
12	30	10	20
14	36	30	6
16	20	14	6
18	12	6	6
20	2	2	0
22	4	4	0
Totals	176	98	78
Average DBH	11.7	12.4	10.8

An example of a silvicultural thinning that removed trees from the lower and middle part of the diameter distribution in the stand is shown in Table 3. In such a thinning you tend to retain the larger trees and cut trees that are in competition with one another to increase the average stand diameter. In this example, the average stand diameter before the cut was 11.7 inches and after the cut was 12.4 inches. By cutting this way, you keep the fastest growing trees, shorten the time to the next cut, and redistribute the growth in the stand to the more valuable trees.

Crown Classes

Because trees compete with one another for light, moisture, and nutrients, your management plan should focus on redistributing light to those trees that meet your objectives and respond with increased growth. In even-aged woods, understanding how trees compete in the forest canopy is important. Knowing where individual tree crowns are in the canopy and how they will respond to increased light is basic to implementing intermediate treatments or thinnings.

The crown is the uppermost part of the tree. It contains the smaller limbs and the leaves that collect sunlight and enable the tree to carry on photosynthesis. Crown classes are referred to as being dominate, codominate, intermediate, and

suppressed or overtopped. Dominate crowns are the largest in the forest. They receive sunlight from the top and some from all sides. Usually, when you look up, they are fully round. Codominate crowns receive full sunlight from the top and very little to no sunlight on the sides. These crowns are often flattened on one or more sides where they compete with other codominate crowns. Intermediate crowns are shorter but extend into the upper canopy of the forest. They receive limited sunlight from the top and no sunlight from the sides. Suppressed or overtopped crowns are the smallest trees and receive no direct sunlight from any angle.

Intermediate thinning harvests seek to improve conditions for the codominate trees by removing competition and encouraging them to develop fuller, more balanced crowns. Intermediate crowns, depending on the tree species and its shade tolerance, may also respond to thinning. Shade-tolerant species, such as hemlock and sugar maple, will also increase their crown size with more sun. Intermediate shade-tolerant species, such as red and white oak and red maple, may increase crown size, but you need to evaluate the percentage of the crown relative to the total height and its overall health. If these trees have less than 30 percent of their total height in leaf surface, they will likely respond very poorly.

The important point when conducting intermediate treatments is to avoid diameter- or species-driven cutting decisions. Select trees to improve the overall quality of the forest or woodlot. If you select trees only on size or species (for example, all the red and white oak), this is termed high grading. Tree DBH does not represent age well. Harvests designed to cut just big trees to release smaller DBH trees are likely poorly designed and will remove the best trees and leave only weak trees. Using these practices will greatly reduce overall productivity and future income, as well as greatly extend the time it takes to grow large, high-quality trees.

Eventually, after several intermediate thinnings in an even-aged woodlot, you will have to consider when to regenerate. If you have scheduled your thinning operations well, you should have advanced regeneration in place under the large overstory crowns. Your forester will help you achieve this outcome and advise you on when to do an overstory removal, releasing the next forest.

Crop Trees

Crop trees are those you wish to retain until later in the stand's development. It is often a good idea to select and mark these trees. By doing this, you focus on the trees you want to keep and can more easily decide which trees need to be cut because they are competing for light and nutrients with your crop trees. Crop trees should be desirable species, with healthy intermediate and codominate crowns, and have clean, defect-free trunks of good form. Avoid selecting crop trees with weak crowns or obvious defects. Crop trees should be evenly spaced when the stand matures, with 80–120 trees per acre. This is approximately one tree every 20 feet by 20 feet. These are only general guidelines; sometimes trees will be closer together. Always look up and consider how you can remove competition and help balance or round out the crowns. Providing room to grow is your target.

Conclusion

A properly managed woodlot can be viewed as a valuable savings account. Making sure that it provides income when you need it involves having an up-to-date management plan and working with a professional forester. Having a chainsaw and knowing how to fell trees does not make you a professional logger. Woodlots represent a commitment to stewardship. It takes four or five generations to grow a high-quality woodlot in Pennsylvania. One or two poorly planned and implemented harvests can destroy that woodlot for generations to come.

Sample Budget

Following are two tables that may help you predict future income from timber. Working with a consulting forester before making any decisions about timber harvest is highly recommended.

Budgeted costs and returns are often difficult to estimate because they are numerous and variable. Therefore, consider these yield and price estimates as an approximation

Table 4. Example yield per acre and stumpage value for an intermediate hardwood thinning.

DBH (INCHES)	NUMBER OF TREES CUT	VOLUME[1]	TOTAL VOLUME	TIMBER MARKET PRICE[2]	STUMPAGE VALUE
6	16	0.11	1.76	$1.44	$2.53
8	10	0.16	1.6	$1.44	$2.30
10	14	0.24	3.36	$1.44	$4.83
12	20	56	1,120	$221	$247.52
14	6	78	468	$221	$103.43
16	6	106	636	$368	$234.05
18	6	136	816	$368	$300.29
20	0	290	0		
22	0	355	0		
Total	78				$892.43 per acre

1. For trees 12 inches and larger with a log height of 16 feet. Measured with a ¼-inch International rule. Volume is in tons per tree. Source: Richard G. Oderwald and James E. Johnson, "Measuring Standing Trees and Logs" (Blacksburg: Virginia Cooperative Extension, 2009), http://pubs.ext.vt.edu/420/420-560/420-560.html.

2. Based on Pennsylvania Timber Market Report, First Quarter 2010, Northwest Region private sales using low prices for 12 through 14 inches DBH and average prices for 16 and 18 inches DBH.

and make appropriate adjustments in the "Your Estimate" column to reflect your specific production and resource situation. More information on using crop budgets is available in *Agricultural Alternatives: Enterprise Budget Analysis.*

The income from an improvement cutting like that in Table 3 is used as an example. It represents removals from one acre of hardwoods following a typical thinning prescription that focuses on thinning in the smaller diameter classes and retaining larger trees. While this does not provide the highest immediate return, it will yield higher returns in the long term.

The assumption in this example is that all trees were scaled as only containing one 16-foot log. While this is not likely the case, it allows for using the volumes provided in Table 1 for standing tree volumes. To find volumes for other log lengths, refer to "Log and Tree Scaling Techniques" at **www.extension.purdue.edu/extmedia/FNR/FNR-191.pdf**. The estimated yields are based on measurement with an International log rule. To further simplify this example, red oak is the only species considered, which is an unlikely scenario for Pennsylvania forests. Harvest of a single high-value species such as red oak would be considered high grading and is not recommended. The second table, which lists a range of sawmill prices for various tree species, can be used to further refine the estimated income potential from your woodlot. Consult the most recent version of the *Pennsylvania Timber Report* **(extension.psu.edu/timber-market-report)** for the latest prices.

For More Information

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Wagner, J. E. *Forestry Economics: A Managerial Approach.* Florence, KY: Taylor and Francis, 2011.

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Online Resources

Pennsylvania Department of Conservation and Natural Resources Bureau of Forestry:
www.dcnr.state.pa.us/forestry/index.aspx

Penn State Extension publications on private forests:
extension.psu.edu/private-forests/tools-resources/publications

United States Forest Service:
www.fs.fed.us

Table 5. Average log prices, by species and grade, reported by sawmills for delivered logs in northwestern Pennsylvania (early 2010 prices).

	QUALITY				
SPECIES	GRADE 3 (LOW)	GRADE 2 (MED.)	GRADE 1 (HIGH)	VENEER (VERY HIGH)	YOUR ESTIMATE
	($/MBF, INTERNATIONAL ¼-INCH RULE)*				
Red oak	189	380	571	700+	
White oak	124	255	386	700+	
Black cherry	372	702	1,032	2,000+	
White ash	78	138	197	350+	
Hard maple	166	260	354	—	
Soft maple	82	186	290	—	
Yellow poplar	59	144	229	—	
Misc. hardwoods**	38	58	78	—	
Pine and hemlock	17	27	35	—	

*MBF = thousand board feet.

**Miscellaneous hardwoods include beech, hickory, basswood, and black gum.

Prepared by James C. Finley, professor of forest resources; Lynn F. Kime, senior extension associate; and Jayson K. Harper, professor of agricultural economics.

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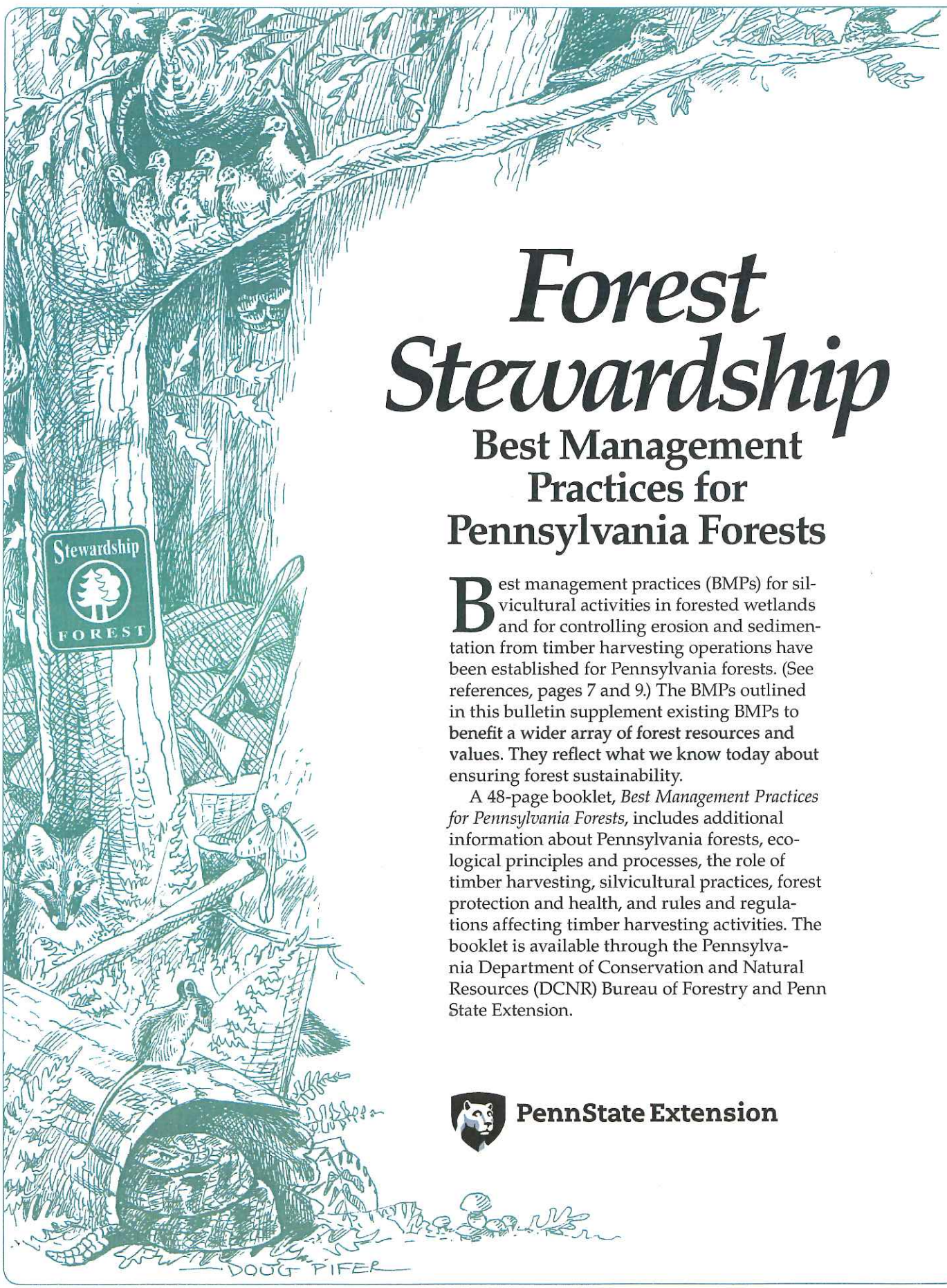

Forest Stewardship

Best Management Practices for Pennsylvania Forests

Best management practices (BMPs) for silvicultural activities in forested wetlands and for controlling erosion and sedimentation from timber harvesting operations have been established for Pennsylvania forests. (See references, pages 7 and 9.) The BMPs outlined in this bulletin supplement existing BMPs to benefit a wider array of forest resources and values. They reflect what we know today about ensuring forest sustainability.

A 48-page booklet, *Best Management Practices for Pennsylvania Forests*, includes additional information about Pennsylvania forests, ecological principles and processes, the role of timber harvesting, silvicultural practices, forest protection and health, and rules and regulations affecting timber harvesting activities. The booklet is available through the Pennsylvania Department of Conservation and Natural Resources (DCNR) Bureau of Forestry and Penn State Extension.

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This publication is written under the assumption that voluntary compliance with BMPs, reinforced with education, will serve all of us better in the long run, both economically and socially. In practical terms, voluntary compliance in implementing BMPs can help avoid the establishment of additional regulatory statutes, many of which can be burdensome, time consuming, costly, and not necessarily conducive to long-term forest health and productivity.

BMPs are universally accepted activities that have positive effects or minimize negative effects on the forest ecosystem. Their impacts can be limited to individual stands or spread over multiple ownerships. Some BMPs are multipurpose. For example, *buffer strips* along streams designed to control sedimentation can also serve as wildlife travel corridors, result in habitat diversity, and maintain stream water temperature and nutrient levels.

BMPs must remain flexible over time to accommodate changes in the social, economic, and environmental contexts of forest resource use. Our education in this area must be ongoing.

The BMPs provide the basics—minimal acceptable standards—of good forest management, although some landowners may choose to do more. You will probably want to review the information in this publication with the natural resources professionals who help you manage your land.

The best management practices that follow are divided into three areas of forest management: planning, forest operations, and forest values. Each forest resource management component includes an objective, the primary issue on which the BMPs are based, considerations and concerns regarding the management component, and a checklist of BMPs that address those considerations and concerns. The checklist is provided in general terms. You can get detailed information from the publications listed at the end of each management component, under "For additional information."

HIGH-GRADING

There is concern among all sectors of the forestry community that high-grading—the harvesting of only those trees that will give the highest immediate economic return—may lead to a widespread decline in forest resource quality. Two practices, diameter-limit cutting and selective cutting, generally fall into this category. In diameter-limit cutting, all saleable trees above a certain diameter are harvested. Selective cutting usually removes the largest, most valuable trees and may leave large-diameter, poor-quality, low-value trees. In each case, most of the trees that remain after the harvest are genetically inferior or physically defective. Neither method gives any thought to the composition of the future forest.

In even-aged forests such as those in Pennsylvania, smaller-diameter trees are not necessarily younger trees. It is more probable that these smaller trees are

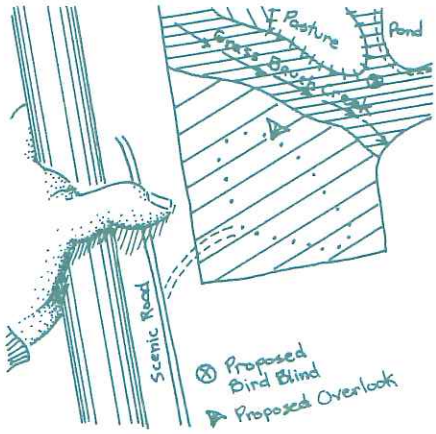
1. slow-growing species of the same age as different, fast-growing species
2. the same species of the same age but growing on an inferior microsite
3. the same species of the same age but genetically inferior to their larger-diameter counterparts.

Because slower-growing and poor-quality trees are retained, high-grading diminishes the diversity and economic value of the future forest. Landowners may agree to high-grading because of a lack of knowledge about the practice and its undesirable consequences. High-grading also can be driven by short-term economic considerations. Immediate cash flow may be higher with high-grading, but potential environmental degradation and decreased future timber values will more than cancel the immediate cash advantage.

Stewardship requires that landowners consider the future consequences of high-grading when making a decision whether or not to accept the use of the practice on their land. Resource professionals and harvesters also have an obligation to look beyond the present when recommending forest management practices to landowners.

Definitions for italicized terms not explained within the text are provided in Forest Stewardship publications "Terminology" and "Timber Harvesting: An Essential Management Tool."

Planning



Objective

To optimize short-term and long-term benefits of forest management activities through adequate planning.

Issue

Management activities undertaken without planning can produce undesirable environmental, economic, and aesthetic consequences.

Considerations and Concerns

1. Many private landowners are not aware of the values available from their forestland.
2. Many private landowners do not define what they want from their forestland.
3. Many private landowners do not involve resource professionals in forest management planning.
4. Forest management activities, particularly harvesting, are often undertaken for short-term gain without thought for the forest's future.

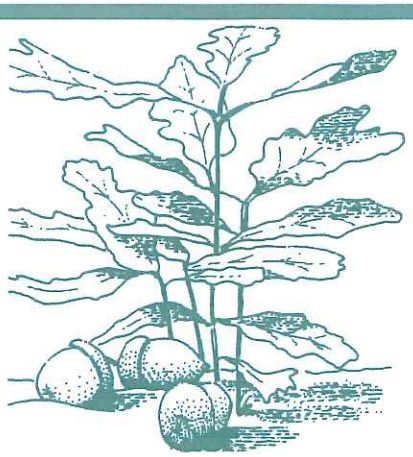
BMPs

1. Inventory resources on the property, including general plant-tree communities, water resources (*streams, spring seeps*—a class of wetland created by groundwater emerging in small pools surrounded by vegetation—*wetlands, vernal ponds*), soils, and unique areas (*endangered, threatened,* or *rare species* habitat, rock outcroppings, notable views).
   a. Initially, inventory at a level of detail necessary to address preliminary goals and objectives.
   b. Later, conduct a more detailed analysis to meet specific landowner operational needs, such as harvesting.
   c. Be aware of how the resources on the property fit in with the surrounding landscape.
2. Work with a natural resources professional to identify preliminary goals and objectives.
3. Mark and maintain property boundary lines.
4. Develop realistic goals and objectives based on the resource inventory and available landowner time and finances. Be as specific as possible when enumerating objectives (e.g., does "managing for wildlife" mean creating habitat for a wide variety of wildlife or concentrating on habitat requirements for one or two species).
5. Consider the effects of planned activities on surrounding properties.
6. Create a written management plan based on the resource inventory and landowner objectives. Include a map showing stands or management units and a timetable for completion of recommended activities.

For Additional Information

Harvey, Helene, and James C. Finley. "Forest Stewardship: Planning Your Forest's Future." University Park: Penn State Extension.

Forest Operations



REGENERATION AND RENEWAL

Objective

To ensure that the forest of the future is productive.

Issue

Timber is being harvested without regard for forest regeneration and renewal (growth of a new forest plant community).

Considerations and Concerns

1. Pennsylvania's forests are maturing; harvesting should lead to renewal.
2. Preharvest assessment of advanced regeneration and potential problems will minimize the possibility of regeneration failure.
3. Deer are having a major impact on forest regeneration.
4. Pennsylvania forests lack advanced regeneration of desirable species.
5. Once seed sources of desirable species are gone, it is difficult to reproduce a productive forest for the future.

BMPs

1. Assess advanced regeneration, seed sources for postharvest regeneration, and potential stump and root sprouting.
2. Assess and, if necessary, control competing vegetation such as ferns, grasses, and other undesirable *understory* tree and shrub species.
3. Assess and, if necessary, control the potential loss of seed, seedlings, and sprouts to deer and other wildlife.
4. Provide for regeneration each time harvests are made under the uneven-aged system.
5. Consider the biological requirements of the species you want to regenerate, whether by natural reproduction or planting.

For Additional Information

Bihun, Yuri, James C. Finley, Stephen B. Jones, and Ellen Roane. "Forest Stewardship: Timber Harvesting: An Essential Tool of Forest Stewardship" University Park: Penn State Extension.

Jackson, David R., Michael T. Wolf, and Jim Finley. "Forest Science Fact Sheet: Regenerating Hardwood Forests: Managing Competing Plants, Deer, and Light." University Park: Penn State Extension.

Forest Operations

TENDING

Stand—Residual Stand Protection

Objective

To minimize the negative impacts of management activities on vegetation remaining on the site.

Issue

The stand that will remain after intermediate treatments is subject to damage or degradation during forest management operations.

Considerations and Concerns

1. Intermediate treatments should leave the forest in better condition than it was in before the activity was undertaken.
2. Careless operation of equipment results in damaged trees.
3. Proper planning can minimize the chances of damaging or degrading the residual stand.

BMPs

1. Focus on protection of the residual stand rather than on the trees being removed.
2. During intermediate operations, retain seed source of species needed to achieve long-term management objectives.
3. Avoid intermediate cuttings that may increase interfering plant communities, such as grasses and ferns, or be prepared to treat interfering vegetation before the regeneration cut.
4. Design and lay out *skid trails* (trails used to drag logs that require less construction than skid roads because of less frequent use) and *skid roads* (designed for frequent use by skidding equipment and usually incorporating

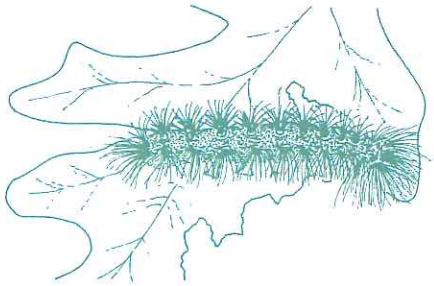
water control structures) to minimize damage by avoiding residual trees and using *bumper trees* (trees left standing along skid trails and roads until the end of the harvesting operation) to protect them from skidding damage.

5. Exercise special care when harvesting trees during the growing season (usually between April and August), when residual trees are most susceptible to felling and skidding damage.
6. Identify and mark unique vegetation to be protected.
7. Ensure that a stand compatible with long-term management objectives remains after intermediate treatments. Instead of selecting for cutting, select for retention:
   a. species adapted to the site
   b. trees not likely to develop *epicormic branching* (branching that occurs after other branches have developed higher on the tree trunk) from exposure to increased sunlight
   c. properly spaced trees
8. Avoid high-grading (see page 2).

Forest Operations

TENDING

Stand—Insects, Diseases, and Fire



Objective

To minimize the adverse effects of insects, diseases, and fire on forest resources.

Issue

Insects, diseases, and fire can make it difficult to accomplish forest management goals and objectives.

Considerations and Concerns

1. Most landowners and some resource professionals fail to recognize the effects of insects and diseases on forests.
2. Proper management can minimize the impacts of insects and diseases.
3. Landowner objectives may have to be modified to deal with insects and diseases.

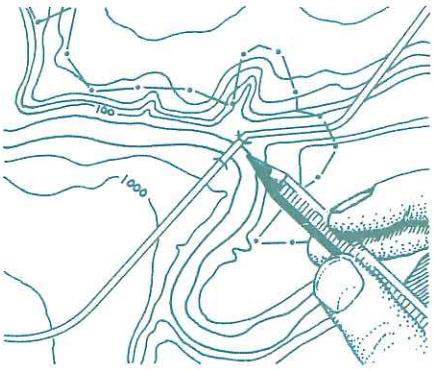
BMPs

1. Monitor insect and disease populations.
2. Take appropriate control measures when insects or diseases are likely to prevent the accomplishment of landowner goals and objectives.
3. Consider increasing species diversity, changing species composition or stand structure to minimize susceptibility to insect and disease attack.
4. Maintain access roads to facilitate fire control.
5. Consider a timber harvest to salvage dead and dying trees.

For Additional Information

Skelly, J. M., et al. *Diagnosing Injury to Eastern Forest Trees.* USDA Forest Service, Forest Pest Management and The Pennsylvania State University.

Forest Operations



TENDING

Site Quality Protection—Productivity

Objective

To protect the soil's ability to sustain desired plant and animal communities.

Issue

Operations at the wrong location and during inappropriate weather can damage soil structure and lower *site quality.*

Considerations and Concerns

1. Current equipment makes it possible to move large volumes of timber in all kinds of weather and soil conditions.
2. Careful removal of forest products can be the key to having a productive forest in the future.
3. Soil compaction inhibits regeneration.
4. Deep ruts can damage roots, which can lead to decay, stain, reduced growth, and mortality.

BMPs

1. Minimize soil compaction and rutting by matching operating techniques, season of operation, and equipment to soil types and moisture levels.
2. Use soil surveys, topographic maps, and on-site evaluations as guides when planning *log landing* (area at end of a skid road where harvested timber is stored or prepared for transport), skid road, and *haul road* (road used by trucks to move harvested timber from the log landing to its destination) locations.
3. Modify landing and road locations to reflect actual soil, *parent material* (rock from which soil is derived), and topographic conditions.
4. Keep the landing and road network at minimum size necessary to remove harvested timber efficiently.
5. Do not contaminate soils with fuels, lubricants, and other chemicals.

For Additional Information

Department of Environmental Protection, Bureau of Watershed Management. 2009. *Timber Harvest Operations Field Guide for Waterways, Wetlands, and Erosion Control.* Harrisburg, Pa.

Forest Operations

TENDING

Site Quality Protection—Water Resources

Objective

To minimize the movement of soil into water resources during forest management operations.

Issue

Erosion and sedimentation from forest management activities can affect water quality.

Considerations and Concerns

1. Operations that affect soil and water are regulated by law.
2. Small changes in the operation can eliminate many of the negative impacts.
3. Forested wetlands are often difficult to identify, especially during dry seasons.

BMPs

1. Comply with all provisions of Chapter 102 and Chapter 105 of the Clean Streams Law and the Dam Safety and Encroachments Act, respectively.
2. Design roads to shed surface water quickly.
3. Design roads and landings to prevent or divert surface water flow.
4. Avoid locating roads and landings on *seasonally wet* soils (refers to wetlands that have water at or near the surface only during periods of abundant rainfall or snow melt).
5. Consider slope when laying out roads and landings.
6. Provide adequate riparian buffers between disturbed areas, such as roads or landings, and streams or wetlands.
7. Bridges and culverts are the preferred methods of crossing *intermittent* (not flowing continuously throughout the year) and *perennial* (continuous flow) streams.
8. Cross wetlands only when absolutely necessary.
9. If forest operations necessitate taking heavy equipment into wetlands, conduct those operations, whenever possible, during the driest periods or when the wet area is solidly frozen.
10. Do not skid through water courses or spring seeps.
11. Do not contaminate water bodies and soil with forest management chemicals and petroleum products.

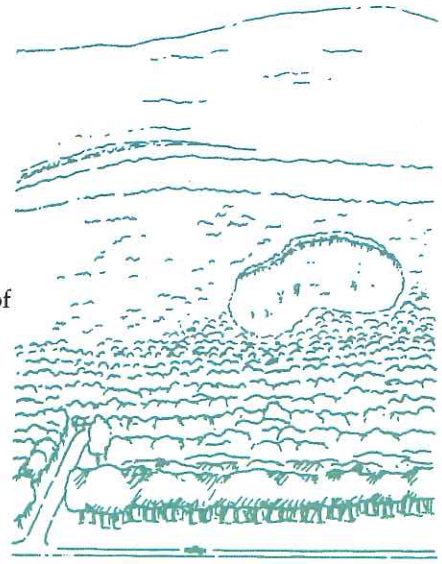
12. Retire the road network properly at the completion of operations.

For Additional Information

Department of Environmental Protection, Bureau of Watershed Management. 2009. *Timber Harvest Operations Field Guide for Waterways, Wetlands, and Erosion Control.* Harrisburg, Pa.

Forest Values

AESTHETIC CONSIDERATIONS



Objective

To minimize the adverse visual effects of harvesting and other forest management activities.

Issue

Much of the opposition to forest management activities, particularly harvesting, is due to the changed physical appearance of the area.

Considerations and Concerns

1. Most landowners are concerned about the appearance of their property.
2. Acceptance of forest management activities by the general public is increased by having the job look good.

BMPs

1. Cut all broken trees, *leaners* (trees tipped or dislodged during a harvesting operation), and badly scarred trees except where they are being retained for a specific purpose.
2. Locate landings away from public view.
3. Protect and release from competition trees with unusual shapes and colors.
4. Design cutting areas to take advantage of natural contours; avoid straight lines when possible.
5. Lop (cut up) tops of harvested trees near public roads, frequently used trails, recreational areas, and residential sites. (Note: This might increase the adverse impacts of deer on regeneration since intact tree tops left behind help protect young growth.)
6. Use as much of the harvested wood as possible to minimize debris. (Note: This might reduce habitat for small mammals, reptiles, amphibians, and beneficial insects.)
7. Clean up all *refuse* (human-made debris) daily.
8. Regrade and seed landings using native grasses wherever possible.
9. Keep mud off public roads and out of streams.
10. Consider leaving a visual buffer along traveled roads.

For Additional Information

Kendra, Angelina, and Ellen M. O'Donnell. "Forest Stewardship: Planning for Beauty and Enjoyment." University Park: Penn State Extension.

Forest Values

UNDERSTANDING WILDLIFE HABITATS

Objective

To consider the impacts of forest management activities on wildlife resources and understand the trade-offs necessary to accomplish landowner goals and objectives.

Issue

Forest management activities have positive and negative effects on wildlife resources.

Considerations and Concerns

1. Wildlife is important to landowners and the general public.
2. The effects of forest management activities on wildlife are often overlooked.

BMPs

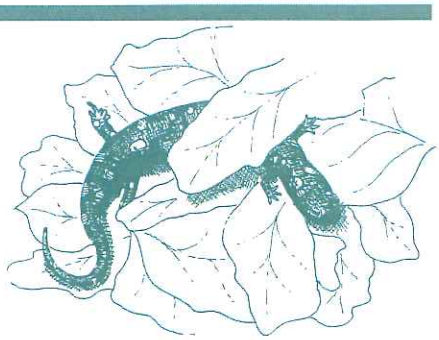
1. Inventory habitat features on the property and be aware of their relationship to surrounding lands.
2. Protect sensitive habitats, such as spring seeps, vernal ponds, riparian zones, cliffs, caves, and *rubble land* (area with high content of large rock fragments).
3. Develop missing special habitats, such as evergreen cover, grape arbors, and herbaceous (nonwoody plants) openings, through planting, cutting, or other manipulations.
4. Protect cavity trees, snags, and food-producing shrubs and vines.
5. Maintain overhead shade along cold-water streams.
6. Use forest management activities to develop habitats required by species desired by the landowner.

For Additional Information

Brittingham, Margaret, and Colleen DeLong. "Management Practices for Enhancing Wildlife Habitat." University Park: Penn State Extension.

Sullivan, Kristi L., and Margaret C. Brittingham. "Forest Stewardship: Wildlife." University Park: Penn State Extension.

Forest Values



SPECIES OF SPECIAL CONCERN AND UNIQUE HABITATS

Objective

To recognize the importance and contribution of unique or special resources to the ecological integrity of the property and the Commonwealth.

Issue

Unique areas and plant and animal species of special concern need to receive specific attention in forest management activities.

Considerations and Concerns

1. Landowners often are unaware of the existence of species of special concern or unique areas on their properties.
2. Many landowners would be willing to protect special resources on their properties if they had information and advice on what actions to take to protect them.
3. The loss of additional endangered, threatened, or rare species will diminish the biological wealth of our state.

BMPs

1. Become aware of the presence of and protect endangered, threatened, and rare species' habitats and unique habitat features.
2. Know the habitat requirements of endangered, threatened, and rare species on the property so that activities can be planned to either avoid disturbing or enhance these habitats.
3. Keep in mind that plant habitats can be very small and specific. Learn to recognize these special microsites (small areas in which soil nutrients, water availability, sunlight, and other resources affect only one or a few trees and other plants).
4. Develop specific management plans for unique areas and habitats with the help of a resource professional.

Regulations Affecting Forest Management

Timber harvesting activities are subject to a number of federal, state, and local regulations. These include Section 404 of the Clean Water Act, Chapter 102 of Pennsylvania's Clean Streams Law, Chapter 105 of Pennsylvania's Dam Safety and Encroachments Act, municipal notification of DEP Permit Application submittal, and Pennsylvania's Fish and Boat Code, Act 175. The Pennsylvania Department of Environmental Protection can provide information about these regulations. Pennsylvania Department of Transportation (PennDOT) regulations that apply include Chapter 441, Access to and Occupancy of Highways by Driveways and Local Roads; and Chapter 189, Hauling in Excess of Posted Weight Limit.

In Pennsylvania, the Right to Practice Forestry Act and the Timber Trespass Law also apply. The DCNR Bureau of Forestry can familiarize you with these regulations, which were enacted to protect landowners and others involved with timber harvesting.

Most municipalities have regulations concerning zoning and land use. A growing number of municipalities also have regulations concerning earth moving, timber harvesting, and other activities associated with forest management. These regulations vary considerably from one municipality to another, so be sure to familiarize yourself with the laws in your area.

Prepared by Shelby E. Chunko, former stewardship project associate, and Wilbur Wolfe. Revised by Allyson Muth, forest stewardship program associate.

Cover illustration by Doug Pifer. Illustrations on pages 3 through 11 by Patrick Britten.

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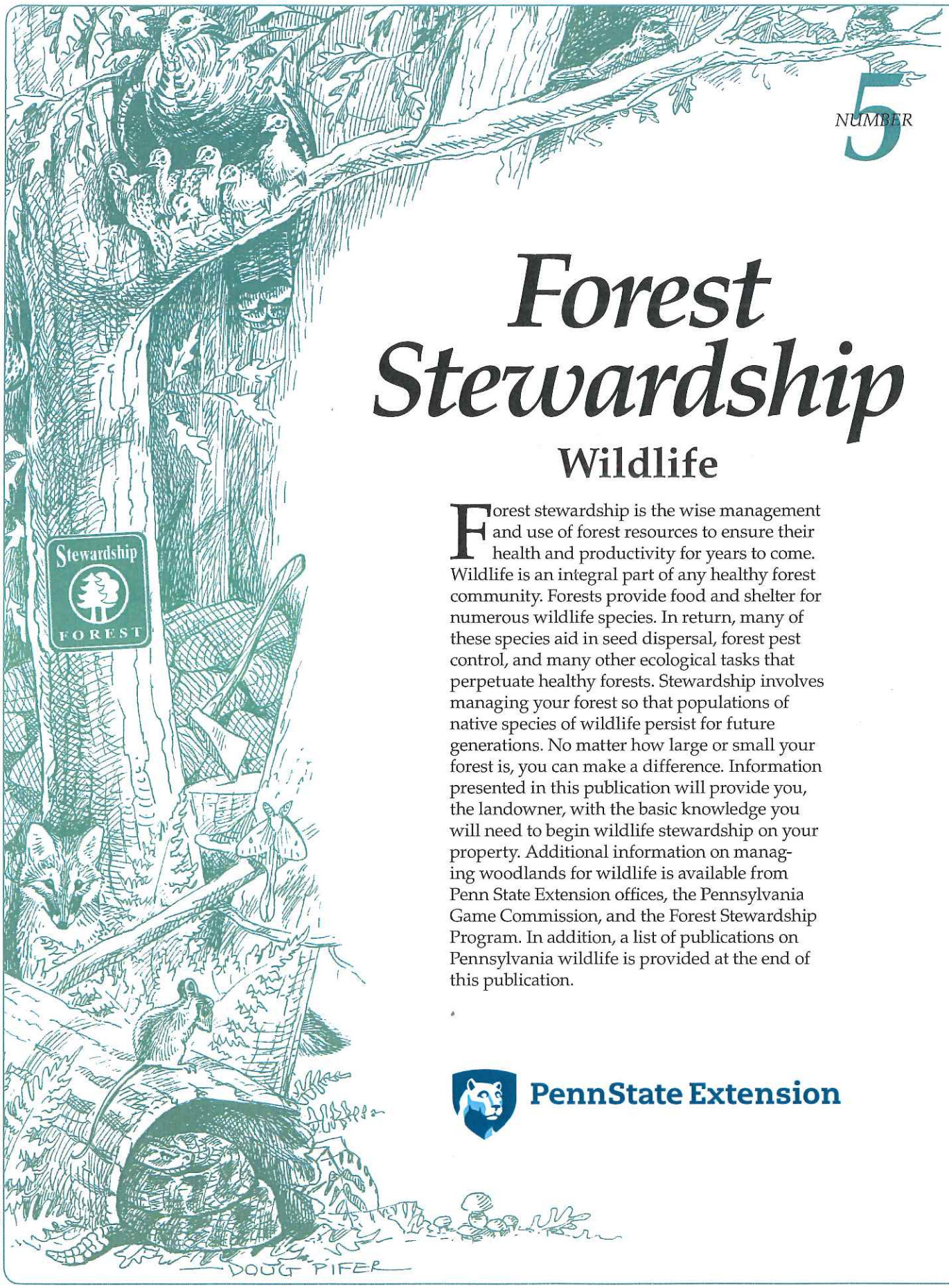
The Forest Stewardship Program is administered nationally by the USDA Forest Service and is directed in Pennsylvania by the DCNR Bureau of Forestry with assistance from a statewide steering committee. The Forest Stewardship Program assists forest landowners in better managing their forestlands by providing information, education, and technical assistance. For more information about program services, contact the Pennsylvania Forest Stewardship Program, DCNR Bureau of Forestry, PO Box 8552, Harrisburg, PA 17105-8552; phone: 717-787-2160. For more information about publications, contact the Pennsylvania Forest Stewardship Program, Department of Ecosystem Science and Management, 416 Forest Resources Building, University Park, PA 16802-4705; phone: 800-235-9473.

Pennsylvania DCNR Forestry



NUMBER 5

Forest Stewardship

Wildlife

Forest stewardship is the wise management and use of forest resources to ensure their health and productivity for years to come. Wildlife is an integral part of any healthy forest community. Forests provide food and shelter for numerous wildlife species. In return, many of these species aid in seed dispersal, forest pest control, and many other ecological tasks that perpetuate healthy forests. Stewardship involves managing your forest so that populations of native species of wildlife persist for future generations. No matter how large or small your forest is, you can make a difference. Information presented in this publication will provide you, the landowner, with the basic knowledge you will need to begin wildlife stewardship on your property. Additional information on managing woodlands for wildlife is available from Penn State Extension offices, the Pennsylvania Game Commission, and the Forest Stewardship Program. In addition, a list of publications on Pennsylvania wildlife is provided at the end of this publication.

PennState Extension

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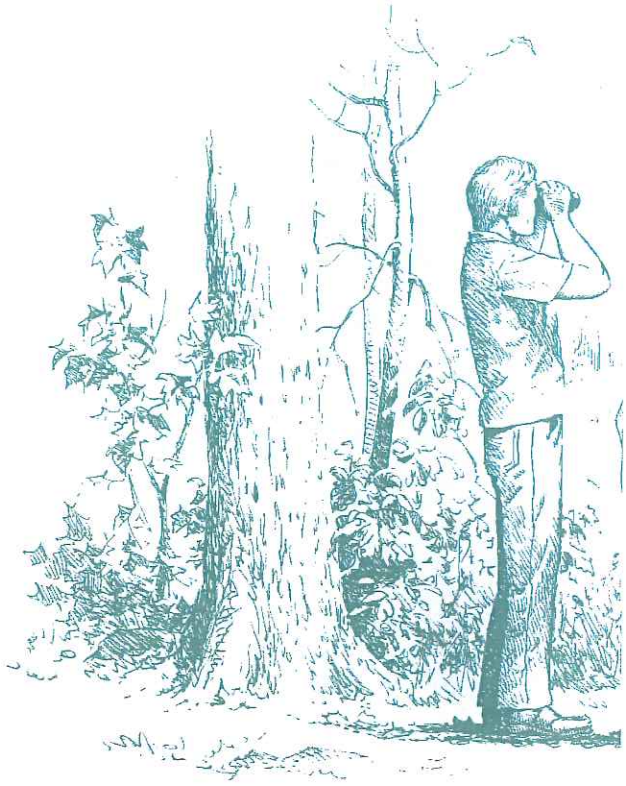


Benefits of Wildlife

As a forest manager, the landowner plays an important role in ensuring that present and future generations can enjoy the many benefits of wildlife. In Pennsylvania, more than 60 percent of all adults participate in some form of recreation related to wildlife. Watching a scarlet tanager alight on a branch, identifying ten species of warblers on your own forest tract, or pursuing a white-tailed deer on a cold November day are all recreational activities associated with wildlife. A major benefit gained from owning forestland is being able to hunt wildlife on your own property. Forest landowners also can enjoy the beauty of wildlife. Listening to a wood thrush sing, admiring a monarch butterfly perched on a milkweed, or watching a red fox dash across a forest clearing can be inspirational and provide a soothing break from an otherwise hectic day.

Although most landowners are aware of the recreational and aesthetic benefits of wildlife, few realize the ecological services provided by the variety of wildlife inhabiting our forests or the multiple benefits associated with these services. Each species performs a specific function in the ecosystem that directly benefits other living organisms, including people. For example, squirrels bury acorns for food but fail to retrieve many of them. Acorns that are not uncovered become a new generation of oak trees. In this way, squirrels help provide for continual forest growth. Many other birds and small mammals distribute seeds throughout the landscape. Blue jays are particularly important in long-distance dispersal of seeds, such as acorns and beechnuts. Jays collect these seeds and carry them to distant sites where they bury them in soft ground or under grass and fallen leaves. In a study of blue jays in Virginia, 50 blue jays transported 150,000 acorns in one month. Some of these were retrieved and consumed by the jays later that year, but many were left to regenerate the forest.

Goshawk

Another ecological function of wildlife is insect control. Bats are insectivorous, feeding on small flying insects, such as mosquitoes, moths, and beetles. A bat may consume as much as one-half its body weight in insects every night, thereby helping control insects harmful to both forests and humans. Birds also consume insects that in large numbers would be harmful to trees. Earthworms and rodents turn over the soil and recycle nutrients. These are just a few examples of the many ecological functions performed by wildlife.

WILDLIFE FOOD PLANTS

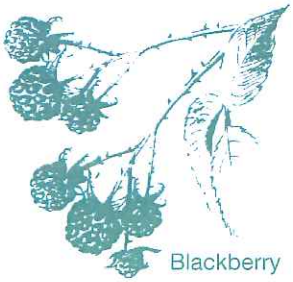
PLANT SPECIES	WILDLIFE SPECIES USING PLANT FOR FOOD	NO. OF SPECIES USING PLANT	SEASONS AVAILABLE[1]
Blackberry	brown thrasher, chipmunk, gray catbird, rabbit, ring-necked pheasant, robin, white-tailed deer	56	S, F
Cherry	black bear, cedar waxwing, raccoon, red squirrel, rose-breasted grosbeak, ruffed grouse, white-footed mouse	56	S, F
Grape	black bear, cardinal, fox sparrow, gray fox, mockingbird, ruffed grouse, wild turkey	53	S, F, W
Ragweed	dark-eyed junco, goldfinch, horned lark, mourning dove, red-winged blackbird, sparrows	49	F, W
Dogwood	bluebird, cardinal, cedar waxwing, rabbit, ruffed grouse, wild turkey, wood thrush	47	S, F, W
Oak	black bear, blue jay, raccoon, ruffed grouse, white-tailed deer, wild turkey, wood duck	43	Sp, F, W
Sedge	horned lark, ruffed grouse, sparrows, wild turkey	43	Sp, S
Bristlegrass	bobolink, cardinal, mourning dove, ring-necked pheasant, red-winged blackbird	40	S, F, W
Serviceberry	beaver, bluebird, cardinal, cedar waxwing, gray catbird, red squirrel, scarlet tanager, veery, white-tailed deer	39	Sp, S
Blueberry	black bear, gray catbird, rabbit, rufous-sided towhee, skunk, white-footed mouse, white-tailed deer	37	S, F
Elderberry	bluebird, brown thrasher, cardinal, indigo bunting, rabbit, rose-breasted grosbeak	36	S
Pine	beaver, black-capped chickadee, brown creeper, gray squirrel, mourning dove, porcupine, nuthatches	33	W
Panic grass	dark-eyed junco, sparrows, red-winged blackbird, wild turkey	32	F
Beech	black bear, blue jay, chipmunk, porcupine, ruffed grouse, squirrels, tufted titmouse, white-tailed deer, wild turkey	31	Sp, F, W
Poison ivy	black-capped chickadee, gray catbird, downy woodpecker, flicker, hairy woodpecker, hermit thrush, wild turkey	28	F, W
Sumac	bluebird, cardinal, black-capped chickadee, hermit thrush, rabbit, robin	28	F, W
Maple	beaver, chipmunk, porcupine, rose-breasted grosbeak, squirrels, white-tailed deer	27	Sp, S, F
Pokeweed	bluebird, cedar waxwing, gray catbird, gray fox, mourning dove, raccoon, red fox	25	F
Greenbriar	gray catbird, hermit thrush, mockingbird, raccoon, ruffed grouse	23	F, W
Birch	black-capped chickadee, beaver, porcupine, rabbit, ruffed grouse	22	Sp, S
Virginia creeper	bluebird, great-crested flycatcher, pileated woodpecker, red-eyed vireo	22	F, W
Hickory	chipmunk, red-bellied woodpecker, rose-breasted grosbeak, squirrels, wood duck	19	Sp, S, F, W
Aspen	beaver, porcupine, ruffed grouse, white-tailed deer	17	Sp, S, F, W
Hawthorn	fox sparrow, gray fox, raccoon, ruffed grouse	15	S, F
Hemlock	black-capped chickadee, porcupine, red squirrel, ruffed grouse, white-footed mouse	13	F, W
Alder	beaver, goldfinch, ruffed grouse	11	Sp, S, F, W

SOURCE: Compiled from Martin, A.C., et al. 1951. *American Wildlife and Plants, A Guide to Wildlife Food Habits.* Dover Publications, Inc.

[1]Sp = spring, S = summer, F = fall, W = winter.

Habitat Requirements Provided by the Forest

To survive, each animal species requires four basic elements—food, cover, water, and space. The combination of these elements required by each animal is referred to as that animal's habitat. When managing your forest, it is important to remember that for a particular species to inhabit your land, each element of that species' habitat must exist in sufficient quantity and quality.



Blackberry

FOOD

A variety of trees, shrubs, vines, and herbaceous plants is needed to provide wildlife with food in each season, but especially in winter when food may be scarce. In general, plants that produce fleshy fruits, nuts, or seeds are valuable wildlife food sources. A variety of plant species also will help to ensure the availability of nuts, acorns, seeds, and fruit. Red and white oaks, for example, may produce acorns in different years. Having more than one species of oak in your forest increases the probability of producing acorns every year.

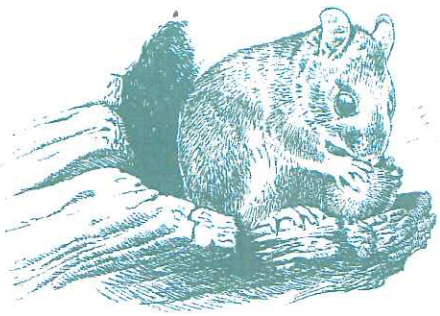
The table on the previous page is designed to help you recognize some of the plant species that provide food for wildlife. The table includes examples of woody and herbaceous species; the number of wildlife species in the northeastern United States that use each plant; examples of specific birds and mammals that use each plant for food; and the season(s) that each species provides food for wildlife. While plants are listed in order of the number of wildlife species that use them, even those used by only a few wildlife species are important.

In addition to plants, many wildlife species feed on insects or other animals. A variety of species, from slimy salamanders and garter snakes to bluebirds, warblers, shrews, bats, and black bears, make insects a part of their diets. Providing habitat for insects (rotting logs, stumps, dead trees or snags, etc.) will in turn provide feeding areas for insectivorous wildlife. Rocks, logs, cavities, and woody materials (e.g., fallen tree tops) also provide habitat for amphibians, reptiles, and small mammals, which in turn serve as food for carnivorous species, such as hawks, owls, several types of snakes, shrews, and red and gray foxes.

COVER

All wildlife requires cover for nesting and protection from predators and adverse weather conditions. Herbaceous forest openings provide ground cover for some nesting birds, as well as travel and escape cover for small mammals. Scattered throughout the forest, brushy areas provide excellent escape and nesting cover for species ranging from songbirds to woodcock and white-tailed deer. Mature forests provide nesting and feeding cover for canopy-nesting birds and cavity-nesting birds and mammals.

You may wish to enhance the cover on your property with evergreens, cavities, and brush piles. Hemlock, white pine, rhododendron, and other evergreens are most commonly used by wildlife as cover from harsh weather conditions. Stands of evergreens provide protection from snow and winter winds. Some birds, such as the mourning dove, nest primarily in evergreens. In addition, evergreen needles or leaves provide food for deer in winter, when other food is



Deer mouse

Ruffed grouse in evergreen cover

scarce. The value of evergreen cover depends upon the species, size, and age of the stand as well as its proximity to other cover types. Evergreens are best located near brushy areas or small herbaceous openings. A variety of wildlife will benefit from a mixture of tall, mature conifers, such as white pine or hemlock, in one area and low-growing evergreens nearby, such as rhododendron, mountain laurel, or young conifers.

Thirty-five species of birds and twenty species of mammals in Pennsylvania use tree cavities for nesting and escape cover. Cavities also are used by various reptiles and amphibians. Cavity trees can be either living or dead. Retaining a combination of both kinds will meet the needs of a variety of wildlife species. Trees of different heights and cavities of different sizes will be of greatest benefit to wildlife. The most valuable cavity trees show evidence of use, such as gnawing around the entrance, or a smooth, worn entrance. They have the following characteristics:

- a healthy crown and the potential to survive for years
- a cavity entrance located where rain cannot enter the hole
- ability to provide multiple benefits for wildlife (e.g., seed production, multiple dens, and cavities in large dead limbs)

Cavities are most valuable when located near streams and forest openings or in proximity to other cover types. For more detailed information on cavities and a list of species that use them, see the Penn State publication *Pennsylvania Woodlands 7: Dead Wood for Wildlife.*

Fallen logs of various sizes, stumps, cut tree tops, and brush piles also can provide cover for wildlife.

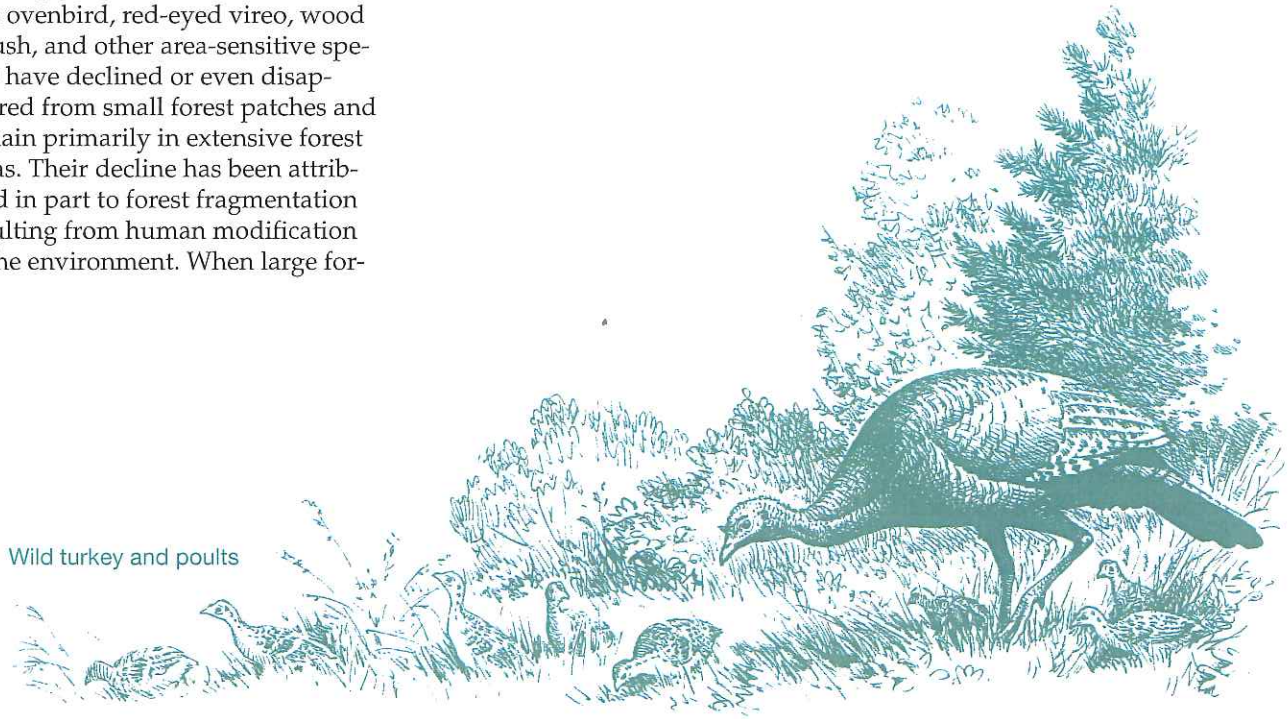
Wood thrush

SPACE

In addition to food and cover, each wildlife species requires space in which to live. This space, referred to as an individual's home range, must be large enough to provide sufficient food, cover, and water to support the animal. Some species, such as the goshawk, have large home ranges and therefore require large continuous areas of forest. Other species, such as many amphibians and reptiles, have poor dispersal abilities and are unable to traverse great distances over terrain with little cover. A simple dirt road, a clearcut, or an agricultural field, for example, may mean the difference between life and death for a dispersing salamander. These species require continuous tracts of forest, unbroken by large clearcuts or agricultural and suburban development.

Many migratory forest songbirds also require extensive forestland. The ovenbird, red-eyed vireo, wood thrush, and other area-sensitive species have declined or even disappeared from small forest patches and remain primarily in extensive forest areas. Their decline has been attributed in part to forest fragmentation resulting from human modification of the environment. When large forest areas are fragmented into several smaller forest areas by suburban development and agricultural activity, the proportion of edge habitat increases. Densities of predatory species such as the American crow, common grackle, raccoon, and opossum also increase. These species prey upon bird nests, eating both eggs and nestlings. Populations of the brown-headed cowbird, a brood parasite, also increase. Cowbirds never build their own nests but instead lay their eggs in the nests of other birds, which often raise cowbird young instead of their own. Large numbers of nest predators and cowbirds have an especially detrimental effect on the reproductive success of migratory songbirds. To breed, many of these species travel long distances from areas such as South and Central America all the way to the Northeastern United States. Because they expend a great deal of energy and time during migration, these species generally nest only once a year and lay fewer eggs than species that live in Pennsylvania year-round. Migratory forest songbirds are usually associated with large forest tracts, because only within extensive forested areas are interior habitat located far enough away from habitat edges.

Although some species require extensive areas of forest, others need a mixture of habitat types. The wild turkey, for instance, requires several habitat types. A flock of turkeys may use thousands of acres during the year to meet its needs. During the spring and summer, turkeys feed on grasses, forbs, seeds, and insects found in forest clearings. In fall, they feed in mature forests containing mast-producing trees, such as oak, beech, and cherry. Fruits of dogwood, grape, crabapple, and cherry also serve as fall food for turkeys. In winter, they rely on mast and fruits left over from autumn and on green plants and insects found in and around spring seeps, where groundwater emerges at the surface along hillsides and lower slopes. Landowners with small acreages cannot expect to provide all of the habitat requirements for wild turkeys. However, you may attract them to your land by providing mature, mast- and fruit-producing trees and shrubs, maintaining a forest clearing, and keeping spring seeps intact on your property.



Wild turkey and poults

WATER

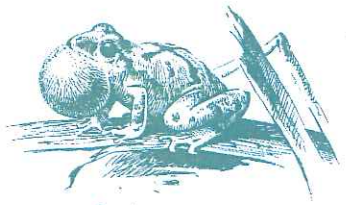
Water is essential for the survival of all wildlife. Some species can obtain water from the food they eat and from dew. Others require a water source. Your woodland may have various types of wet areas. These are valuable to all wildlife species and essential to some species. Streams and rivers, forested wetlands, and spring seeps are three habitat types that supply water to wildlife in Pennsylvania forests.

Wooded areas adjoining streams and rivers are unique habitat known as riparian zones. These areas add diversity to the forest, attracting a myriad of amphibians and an abundance of waterfowl, such as the belted kingfisher, green heron, and Louisiana waterthrush. In addition, riparian zones protect streambanks from erosion and shade the water, thereby preventing stream warming.

Forested wetlands not only supply water essential to wildlife but also provide food and abundant woody and herbaceous vegetation used for cover. The combination of increased availability of water, abundant and diverse foliage for nesting and cover, and increased invertebrate food supplies attracts a higher density of birds than do upland sites, including the common yellowthroat and the prothonotary warbler. Forested wetlands are important nesting and brood-rearing habitat for woodcocks, red-shouldered hawks, and barred owls, as well as black ducks, mallards, and wood ducks.

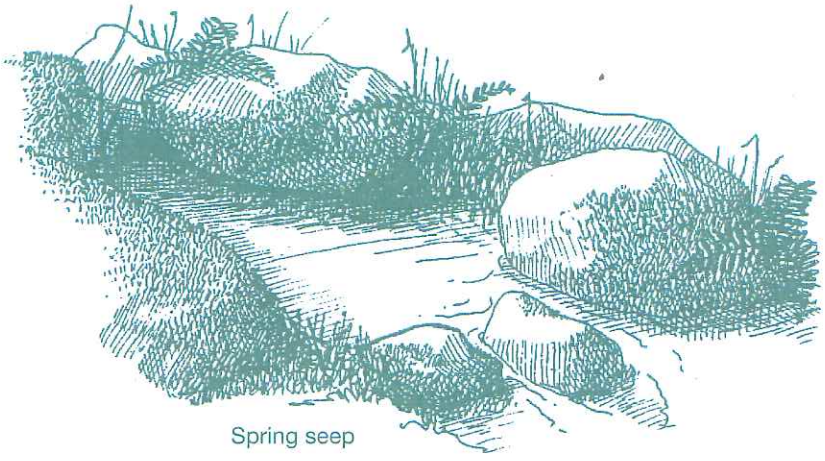
Many mammals likewise inhabit forested wetlands. Small mammals, such as meadow voles and shrews, are common in these areas, providing prey for larger mammals, hawks, and owls. Minks, weasels, raccoons, and beavers also make use of the resources found in forested wetlands. Black bears spend a great deal of time feeding on skunk cabbage and blueberries growing in wooded wetlands during spring and summer. In winter, white-tailed deer find protection in wet forest areas sheltered from the wind. Since snow is not as deep here as in the surrounding upland forest, deer can uncover forbs and grasses to eat.

Spring seeps are common in Pennsylvania forests. Seeps often remain free of snow throughout the winter since the temperature of the groundwater is above freezing. Vegetation and insect larvae found here provide food for wildlife in winter, when food is otherwise scarce or unattainable. The wild turkey, for example, relies on spring seeps for winter food when snowfall is heavy.



Spring peeper

Vernal ponds are small wetlands often found in clusters. While they typically are dry in the summer and fall, they contain water during the winter and spring. These ponds may be found in upland forested areas or may occur along streams and rivers, receiving a fresh supply of water when water levels rise and then recede. The ponds are critical to the reproductive cycle of many organisms in Pennsylvania. Fairy shrimp, caddisflies, fingernail clams, and other aquatic invertebrates have adapted their breeding cycles to these ponds. Many amphibians, including spotted salamanders, American toads, wood frogs, and spring peepers, court and lay eggs in these ponds, then return to the woods for the rest of the year. During the breeding season, thousands of individuals may be found in a pond at one time. Despite their small size, vernal ponds provide a rich supply of food for many organisms and may support the greatest biomass of vertebrates in the forest.



Spring seep

Raccoon

Forest Succession and Wildlife

If undisturbed, an open field over time will be invaded by shrubs, which in turn will be replaced by saplings, young trees, and eventually a mature forest. Foresters often refer to these phases as the grass and forbs stage, shrub and sapling stage, pole stage, and mature forest. In general, plant communities progress in an orderly and predictable manner known as forest succession. However, the rate of forest succession on any one property is difficult to predict and may vary with soil conditions, topography, frequency of natural disturbance, number of deer, and amount of competing vegetation.

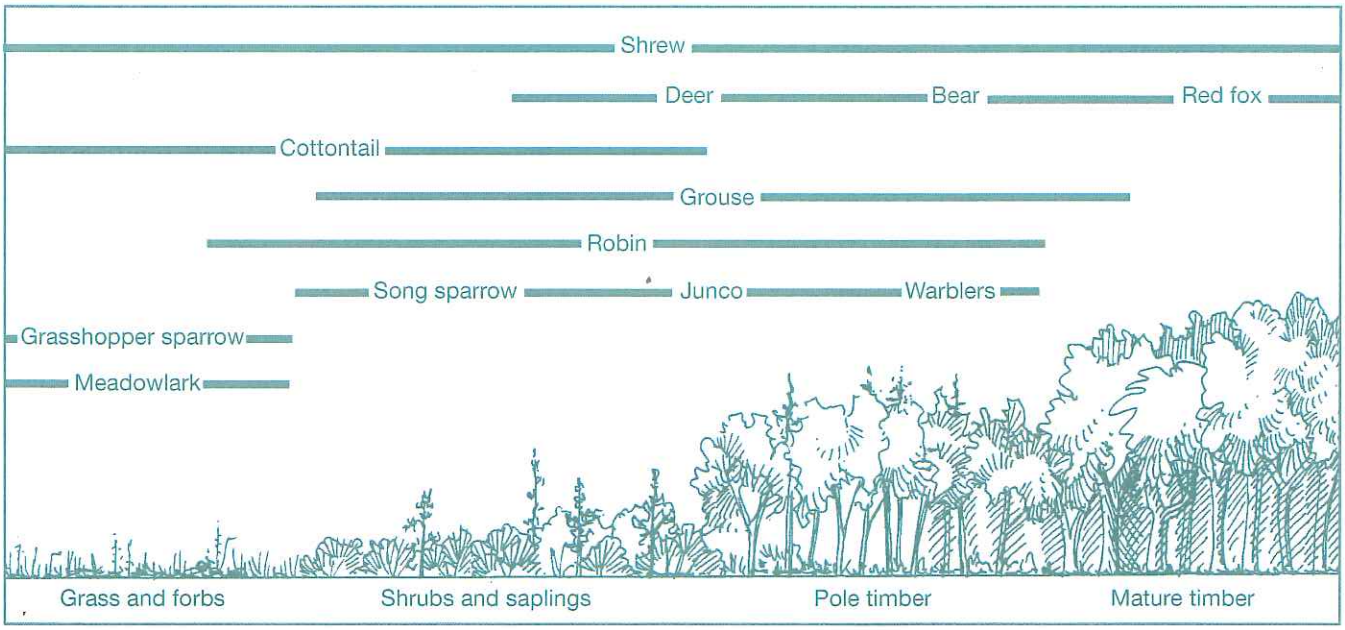
The abundance and kinds of wildlife also change as a forest matures, because the quantity and quality of food, water, cover, and space are changing. Young forests, for example, often have an abundance of berry-producing shrubs and brushy cover, but few hard mast (acorns, hickory nuts) or cavity trees. As a result, species that feed on acorns (e.g, squirrels) or nest in large decaying trees (e.g., pileated woodpeckers) are much more abundant in older forests.

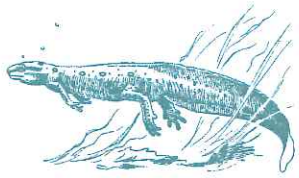
Other kinds of wildlife, including the white-tailed deer, use several stages of plant succession. Deer need the cover provided by thickets of shrubs and saplings, but they also feed extensively on acorns found under trees in a mature forest and seek out succulent green vegetation and grains in agricultural fields. Providing the correct stage or stages of plant succession in the right amount and distribution is the key to attracting wildlife to your property. Whether you wish to manage your land for a variety of wildlife species or for a single species, you will need to know what stage(s) of forest succession each species depends on for food and cover. The table on page 9 lists various wildlife species and the stage(s) of succession each species requires to live.

VERTICAL AND STRUCTURAL DIVERSITY

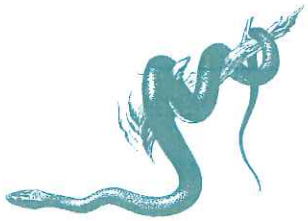
As a forest changes through succession, its structure also changes. Vertical structure is important because in a forest with a well-developed overstory, understory, shrub, and herbaceous strata, a diverse array of plants and animals can coexist. Maintaining vertical diversity within the forest can help to guarantee that a large variety of wildlife will be present. Many wildlife species, particularly birds, divide the habitat vertically. For example, ovenbirds, scarlet tanagers, and chickadees are all found in mature forests, but ovenbirds feed mostly on the ground, tanagers prefer the canopy top, and chickadees like intermediate heights. More species are able to coexist in a forest with multiple layers than in a forest where all the trees are the same height. Vertical diversity is greatest in forests with a large variety of trees of different ages. Within similar forests, vertical diversity is greater in areas with few deer. Large deer populations often browse and remove the lower stratum of vegetation.

Structural diversity refers to the variety, size, and shape of both living and nonliving organisms. Large standing and fallen dead trees, plant species diversity, and vertical diversity all contribute to structural diversity in the forest. Many elements of structural diversity, such as rotting logs and snags, provide hiding places for wildlife and attract insects and fungi which serve as food for wildlife. These elements make a very large contribution to the species richness and ecology of an area.

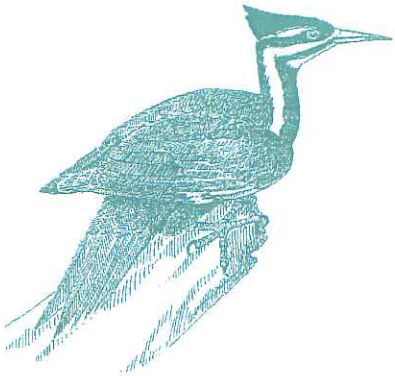




Red-spotted newt



Black rat snake

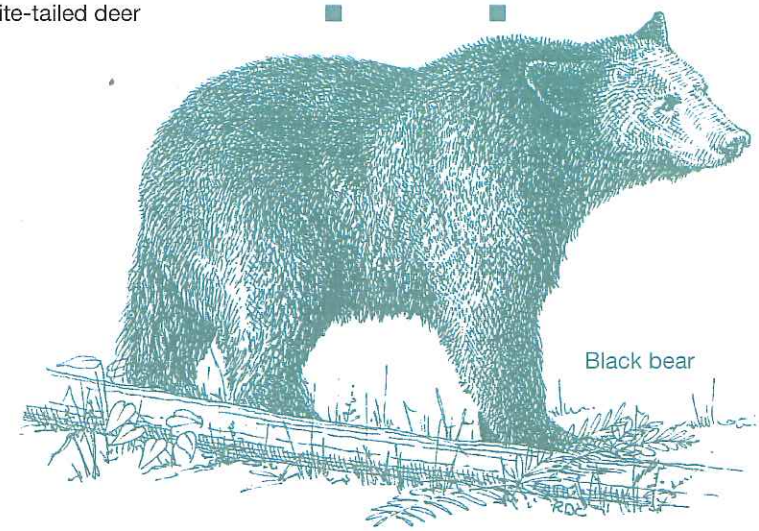


Pileated woodpecker

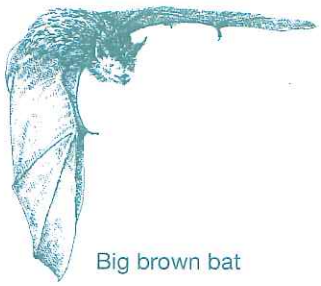
Cottontail rabbit

PREFERRED FOREST SUCCESSIONAL STAGES USED BY SELECTED WILDLIFE SPECIES

SPECIES	GRASS AND FORBS	SHRUBS AND SAPLINGS	POLE STAGE	MATURE FOREST
Amphibians				
American toad	■	■	■	■
Gray tree frog		■	■	■
Red-back salamander			■	■
Slimy salamander			■	■
Red-spotted newt			■	■
Wood frog		■	■	■
Reptiles				
Eastern box turtle	■	■	■	■
Eastern garter snake	■	■	■	■
Northern redbelly snake			■	■
Smooth green snake	■	■		
Wood turtle	■	■	■	■
Black rat snake	■	■	■	■
Birds				
American woodcock	■	■		
Black-capped chickadee		■	■	■
Chipping sparrow	■	■		
Eastern meadowlark	■			
Grasshopper sparrow	■			
Great-horned owl	■			■
Ovenbird				■
Pileated woodpecker				■
Red-eyed vireo			■	■
Red-tailed hawk	■			■
Ruffed grouse	■	■		■
Rufous-sided towhee		■		
Song sparrow		■		
Wild turkey	■			■
Mammals				
Black bear				■
Cottontail rabbit	■	■		
Gray squirrel				■
Meadow vole	■			
Red fox	■			■
White-tailed deer	■	■		■



Black bear



Big brown bat

Management Objectives and Stewardship Plans

For help in developing a management plan that enhances wildlife habitat, you should contact a professional wildlife biologist. These resource professionals can help you evaluate the wildlife potential of your property and develop a workable management plan. Names of wildlife biologists who assist in developing forest stewardship plans are available from your local Bureau of Forestry service forester. The various goals a landowner may pursue when managing for wildlife are discussed below.

SPECIES OF SPECIAL CONCERN

When managing forests, you should give primary consideration to species and habitats that are rare in Pennsylvania. Species of special concern include the snow trillium (plant), giant swallowtail (insect), eastern mud salamander (amphibian), northern goshawk (bird), and northern long-eared bat (mammal). In all, more than 600 plant species are of special concern, along with about 150 vertebrate and 250 invertebrate species. These include aquatic species and species that inhabit open areas and wetlands, as well as woodland species. The Pennsylvania Game Commission, the Pennsylvania Fish and Boat Commission, and the Pennsylvania Bureau of Forestry can provide information on specific species or rare habitats that are present or have existed historically in your region. The Game Commission is responsible for managing threatened and endangered birds and mammals, while the Fish and Boat Commission is responsible for reptiles, amphibians, and aquatic species. The Bureau of Forestry manages threatened and endangered plants and maintains the Pennsylvania Natural Diversity Index (PNDI), which catalogs the existence of species of special concern throughout the state. Properties for which Forest Stewardship Plans are written are entered into the PNDI database to determine whether there is a record of a threatened or endangered plant or animal species existing on or near the site. If you think that you may have a species of special concern on your woodlands, you should confirm this with a resource professional and make every effort to protect the species and its habitat.

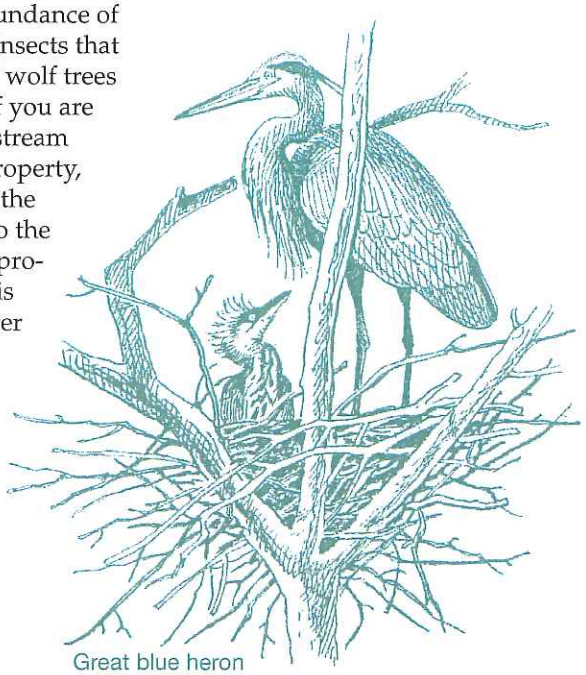
Habitats and communities of special concern also should be protected. Wetlands, a special habitat in Pennsylvania, perform many valuable functions. They control floods, improve water quality, and provide habitat for many species of special concern. Other areas of special concern might include a group of trees where great blue herons are nesting. If your woodlands are a nesting site, or rookery, for these birds, you should minimize disturbance around the nesting colony. You might have a stand of old-growth forest or a single old, large tree on your property. These trees, called wolf trees, are very valuable to wildlife. Cavities form in their trunks at points where branches have died and fallen off. Large old oaks and hickories produce an abundance of mast for wildlife to eat. Insects that invade dead branches of wolf trees are food for songbirds. If you are lucky enough to have a stream running through your property, you will want to protect the wooded areas adjacent to the stream. The best way to protect these riparian areas is to avoid harvesting timber near streams. Wetlands, riparian areas, heron rookeries, old growth forest, and wolf trees are just a few examples of unique or rare features that you may want to protect.

FEATURED SPECIES

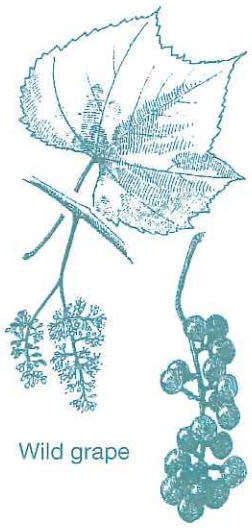
After making sure you have taken species and habitats of concern into consideration, you may decide to manage your woodland or a portion of your woodland to benefit one or more featured species. For example, you may wish to increase the amount of habitat on your property suitable for the ruffed grouse, a native game bird. Ruffed grouse thrive in forests subject to periodic disturbance. Optimum grouse habitat may be created by clearcutting in small, dispersed patches. Good habitat has the following characteristics:

- both food and cover within a 5- to 15-acre area
- brushy areas to provide cover and supply summer and fall foods
- mature forest stands with an understory of grape, greenbriar, hawthorn, witch-hazel, and dogwood to provide food in fall, winter, and spring
- dense stands of saplings to provide brood cover

Another species you may wish to emphasize in your management objectives is the gray squirrel, which prefers deciduous forests with a variety of tree species to provide a varied food supply. A forest that contains many mature mast-producing trees (e.g., oaks and hickories) and a mixture of other tree and shrub species to supply



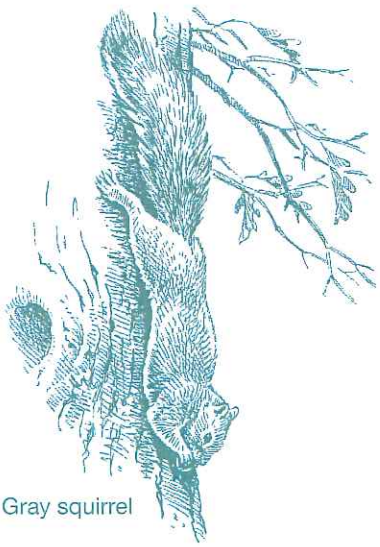
Great blue heron



Wild grape

food throughout the year will support an abundance of squirrels. Squirrels also require den trees for breeding and escape cover. Trees nearing maturity that have one or two openings into a cavity are best. If den sites are scarce on your property, you may erect artificial nest boxes. For information on how to construct boxes, see the Pennsylvania Game Commission publication *Woodworking for Wildlife*.

Managing for a featured species often has tradeoffs. Species whose habitat requirements are similar to those of the featured species will benefit, while those with different habitats will not. If your property is large enough, you may be able to create a balance by managing different parts of your property for different species. If your property is small, you may want to discuss your plan with your neighbors to see if you can develop a larger cooperative plan.



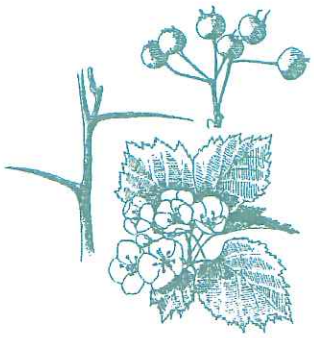
Gray squirrel

GROUPS OR GUILDS

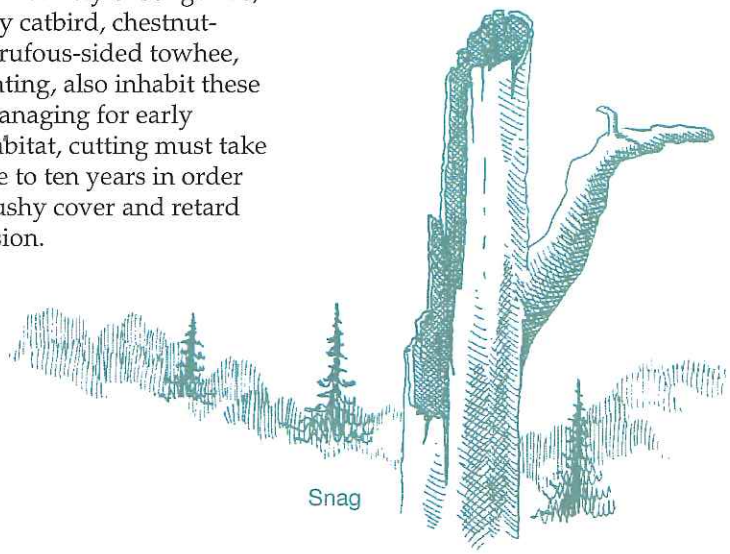
Another option is to manage your forestland to emphasize a particular guild, or group of species that uses the same environmental resources in a similar way. Guilds may require the same cover type, age class, habitat component, or a combination of these factors. For example, you may wish to manage your property for species requiring early successional stages of forest habitat. This habitat, which consists of young trees, shrubs, and vines, is created by clearcutting a portion of forest. Species that use early successional habitat include ruffed grouse, woodcock, white-tailed deer, and cottontail rabbits. A variety of songbirds, such as the gray catbird, chestnut-sided warbler, rufous-sided towhee, and indigo bunting, also inhabit these areas. When managing for early successional habitat, cutting must take place every five to ten years in order to maintain brushy cover and retard natural succession.

Gray dogwood

Another guild you may choose to emphasize in your management plan is migratory forest songbirds, which require large areas of forest. Unlike early successional species, many migratory forest songbirds, including the ovenbird, red-eyed vireo, wood thrush, and many forest warblers, require a different management approach. Many of these species are adversely affected by forest fragmentation and the resulting creation of edge habitat. Area-sensitive songbirds tend not to reproduce well along habitat edges. Management recommendations for these songbirds emphasize maintaining extensive areas of contiguous forest and minimizing creation of edge habitat. Maintaining forest tracts in compact shapes, such as a circle or square instead of linear patches of



Hawthorn



Snag

woods, maximizes forest interior habitat and minimizes edge. In addition, uneven-age management instead of clearcutting minimizes the creation of openings. If you plan to clearcut, you should cluster cuts near existing edges and openings to minimize the creation of new edge habitat.

Early successional species and area-sensitive species are just two guilds you may choose to manage on your property. Many other choices exist, including cavity-nesting species, mast-consuming species, canopy-nesting species, insectivorous species, ground-foraging species, bark-foraging species, and a host of other groups. Some guilds can be managed in conjunction with others, while some are mutually exclusive.

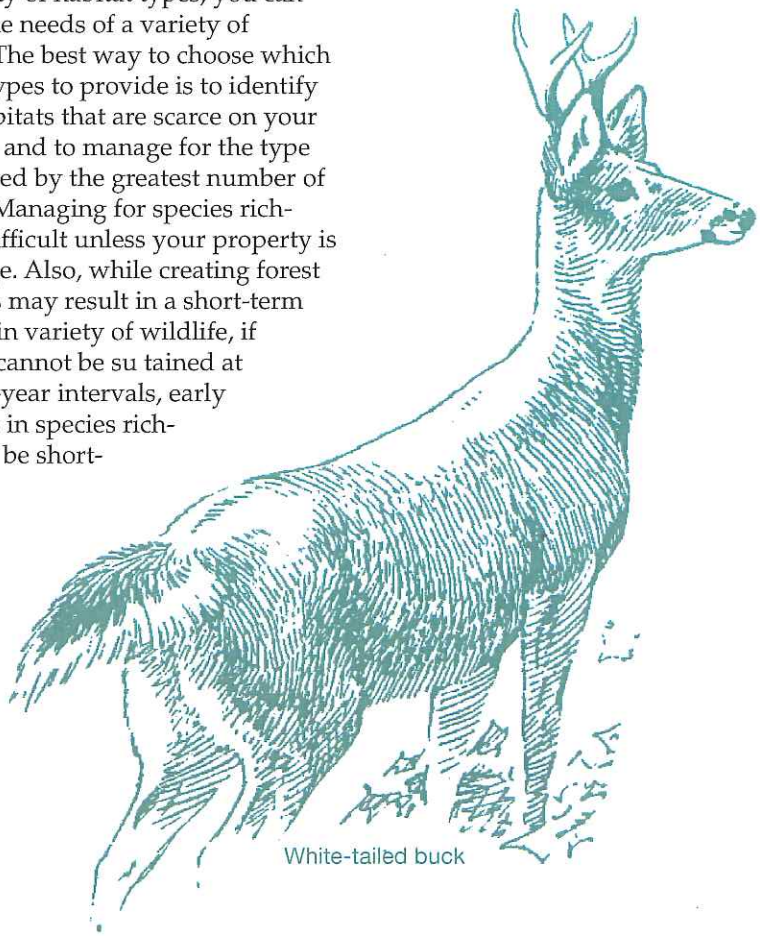
SPECIES RICHNESS

Forest landowners may choose to manage for species richness, or the greatest number of species. This goal is best achieved by creating a mosaic of age class and cover type combinations while also maintaining large areas of mature forest. By creating a diversity of habitat types, you can satisfy the needs of a variety of species. The best way to choose which habitat types to provide is to identify those habitats that are scarce on your property and to manage for the type that is used by the greatest number of species. Managing for species richness is difficult unless your property is very large. Also, while creating forest openings may result in a short-term increase in variety of wildlife, if cuttings cannot be su tained at 10- to 15-year intervals, early increases in species richness will be short-lived.

ENHANCING WILDLIFE FOOD AND COVER

No matter which management objective you choose, the primary way to manage for wildlife is to alter the amount of food and cover present. Once you decide which wildlife species you will be managing for, you may enhance food sources already present on your property through habitat manipulation or you may plant additional native food sources. Practices that enhance wildlife foods are described in the section on cost sharing for wildlife. If enough food sources already grow on your land in sufficient quantities to support the species you have chosen, your best option may be a hands-off approach to management.

Providing a source of year-round cover is an excellent way to enhance your property for wildlife. In many parts of Pennsylvania, evergreen cover is in short supply. If your area has too few evergreens, you may wish to plant native conifers (e.g., white pine or hemlock) or selectively remove other trees that are shading the evergreens. This will release the conifers and allow them to grow more rapidly.



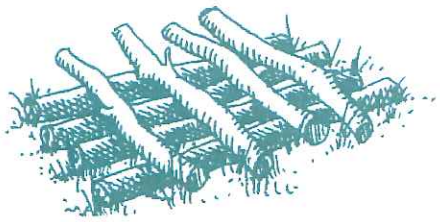
White-tailed buck

Maintaining or creating cavity trees is another way to improve the quality of cover on your property. Retain cavity trees throughout your woodlot. Large trees with large cavity holes are particularly valuable. If your property contains few cavity trees, you may maintain trees that have the potential to become cavity trees. One of the easiest ways to improve the cover on your property is to build brush piles. For more information on how to construct a brush pile, refer to the information in the box on this page.

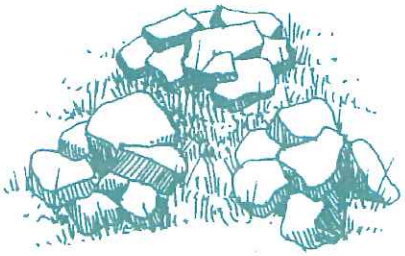
In areas where woodlots are isolated from one another by agricultural fields or suburban developments, maintaining or establishing corridors of trees and shrubs that connect the forest patches will add additional food and cover and may facilitate movement of wildlife from one forested area to another. Corridors of trees and shrubs also can be planted to connect isolated patches of wildlife habitat. For most species, the wider the corridor, the better.

HOW TO BUILD A BRUSH PILE

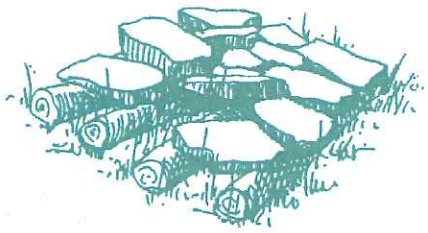
Brush piles may be constructed using one of three types of bases. The first type consists of four large logs placed one foot apart and parallel to each other, with four more logs of the same size stacked perpendicular to the first logs. The second type of base is made by placing large stones in three piles that form a triangle. The third type of base is constructed of logs and stones by placing four large logs about one foot apart and parallel to each other, then placing large, flat rocks across the top of the logs. After you have built the base of the brush pile, add brush to the top starting with the larger limbs first, then adding smaller pieces until the pile is about 6 feet high and 6 feet wide.



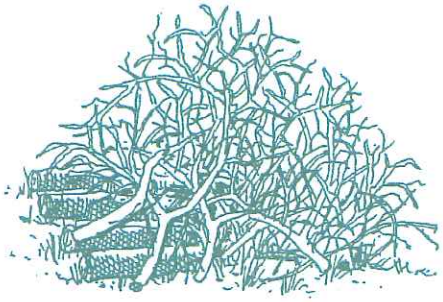
Log base



Stone base



Log and stone base



Brush pile

INCREASING HUMAN/WILDLIFE INTERACTIONS

Regardless of which wildlife species or groups of species you decide to emphasize on your woodland, you may wish to increase opportunities for viewing wildlife by providing trails, forest openings, or nest boxes.

- *Trails:* One way to increase your chances of seeing wildlife is through a wildlife viewing trail. A well-planned trail can provide easy, quiet access to a variety of sites on your property so that you may observe wildlife unobtrusively. For convenience, the trail should form a loop beginning and ending in the same general location. Numerous bends and curves should be incorporated to add an element of surprise and increase the likelihood of flushing a grouse or catching a deer off guard. To maximize the variety of wildlife you may encounter, develop trails through various cover types and near key points of interest, such as a wetland or clump of evergreens. Logging roads may be incorporated as part of the trail.
- *Forest openings:* To provide wildlife food, old logging roads as well as small forest openings can be seeded with native grasses, such as little bluestem, broom-sedge, switchgrass, or Indian grass. These grasses attract wildlife and increase opportunities for human-wildlife interactions by providing forage for deer and seeds for birds and small mammals. In turn, small mammals attract birds of prey, such as hawks and owls. Insect life abounds in tall grasses and provides food for wild turkey and ruffed grouse, particularly in summer when poults feed almost exclusively on insects.
- *Nest boxes:* Providing nest boxes for cavity-nesting birds and animals is a popular activity for Pennsylvanians who enjoy viewing wildlife. Boxes may be placed at the interface between woodland and farmland, around stands of evergreen trees, along wooded stream bottoms, near woodland clearings, or within recent timber harvests. You may attract species such as the black-capped chickadee or the barred owl. Eastern bluebirds, gray and fox squirrels, house wrens, white-footed mice, screech owls, and flying squirrels also use nest boxes. For more information on construction and placement of nest boxes, consult the Pennsylvania Game Commission publication *Woodworking for Wildlife.*

INCORPORATING WILDLIFE INTO TIMBER HARVESTING PLANS

One of your objectives in owning forestland may be timber management. If this is the case, you may still take steps to benefit wildlife. Retaining clumps of conifers or mast-producing trees, for instance, will provide food as well as roosting and nesting cover for wildlife. Dead trees and live trees with cavities should be left to provide shelter and nest sites for species that use cavities or dead wood. Seeding log landings and roads will create excellent wildlife feeding areas. Leaving slash will provide cover for many species. By retaining buffer zones along streams and waterways, you can provide excellent wildlife habitat while protecting water quality. For more information on incorporating wildlife into timber harvesting plans, consult the Pennsylvania Game Commission publication *Timber Sales and Wildlife.*

Bluebird nesting box

Cost Sharing for Habitat Enhancement

Various forest management activities may be implemented to help ensure the perpetuation of a diversity of native wildlife populations. If improving your property for wildlife is one of your management objectives, you may be eligible to receive financial assistance through cost-share programs. Contact your Department of Conservation and Natural Resources Bureau of Forestry service forester or your local Natural Resources Conservation Service office.

Summary

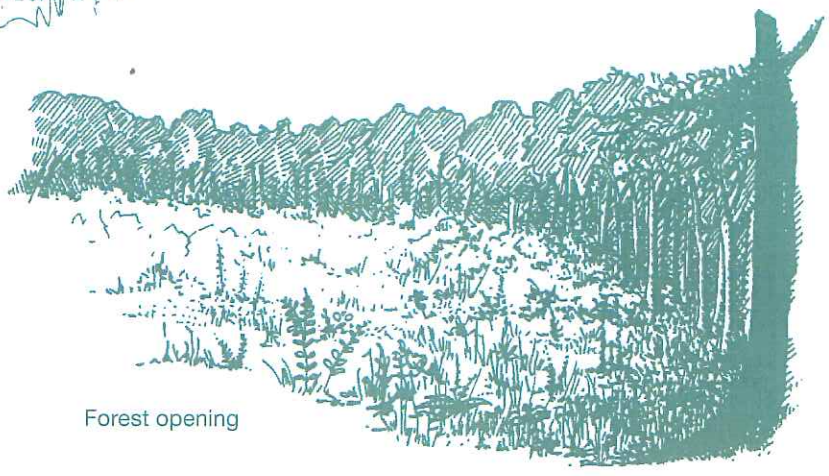
There is no one correct way to be a forest steward or to manage your forest for wildlife. An unlimited number of management options exist, none of which will benefit all wildlife species. Every management decision has tradeoffs. For example, clearing a large portion of forest is not compatible with managing for high mast production to provide food for squirrels, blue jays, and turkeys. When deciding how to best manage your forest, try listing all of the positive and negative effects that each management alternative will have on wildlife before implementing your stewardship plan.

Whatever your specific interests, proper wildlife stewardship is based on managing forests to ensure that native species persist for the enjoyment of future generations. To succeed as a wildlife steward, view your property as just a small piece of a larger puzzle and strive for management options that will provide the most benefits over the longest period of time. Try to use your property to add to regional wildlife diversity whenever possible. This means managing your forest for habitat types, habitat features, and wildlife species that are scarce within Pennsylvania or the Northeast, even if that feature is common on your property. Avoiding or reducing permanent forest fragmentation also can enhance regional diversity. For example, establishing connecting corridors (e.g., fence rows or riparian corridors) between two areas of forest on your property or between areas of forest on your property and a neighbor's land can reduce the effects of fragmentation, as can planting to reduce edge.

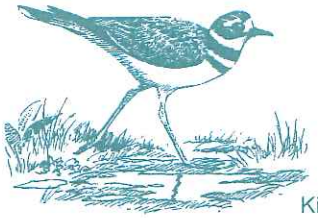
Whether you start with a small project, such as putting up a birdhouse, or a major habitat-enhancement project, keep a record of changes you observe in the species of wildlife on your property. Evaluate the success of your project. Were you able to see more wildlife? Did the project benefit the species you expected it to benefit? Use this information to modify future plans.

Finally, always try to incorporate wildlife needs into any timber management plan. Many wildlife resource professionals in Pennsylvania can help you do this in a way that meets your economic objectives. By taking into account the needs of wildlife on your property, you will be rewarded with endless hours of recreational enjoyment and the satisfaction of knowing that you've helped to ensure that future generations benefit from the diversity of wildlife found in Pennsylvania forests today.

Forest pathway



Forest opening



Killdeer

Additional Reading

PENNSYLVANIA WILDLIFE

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Shaffer, L.L. 1991. *Pennsylvania Amphibians and Reptiles.* Available from the Pennsylvania Fish and Boat Commission, P.O. Box 6700, Harrisburg, PA 17106-7000.

Steele, M.A., M.C. Brittingham, T.J. Maret, and J.F. Merritt. 2010. *Terrestrial Vertebrates of Pennsylvania.* Johns Hopkins University Press.

Wilson, M.A., M.C. Brittingham, and R.S. Mulvihill, eds. 2012. *Second Atlas of Breeding Birds in Pennsylvania.* The Pennsylvania State University Press.

The Pennsylvania Game Commission has numerous publications on Pennsylvania wildlife. For more information and/or a list of publications, write to The Pennsylvania Game Commission, 2001 Elmerton Avenue, Harrisburg, PA 17110-9797.

FORESTS AND WILDLIFE

DeGraaf, R.M., and D.D. Rudis. 1987. *New England Wildlife: Habitat, Natural History, and Distribution.* USDA Forest Service Northeastern Forest Experiment Station. Gen. Tech. Rep.108.

Harris, L.D. 1984. *The Fragmented Forest: Island Biogeography and the Preservation of Biotic Diversity*. University of Chicago Press.

Henderson, C.L. 1987. *Landscaping for Wildlife*. Minnesota Department of Natural Resources, St. Paul, MN 55155-4007.

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Martin, A.C., H.S. Zim, and A. L. Nelson. 1951. *American Wildlife and Plants, A Guide to Wildlife Food Habits.* Dover Publications, Inc.

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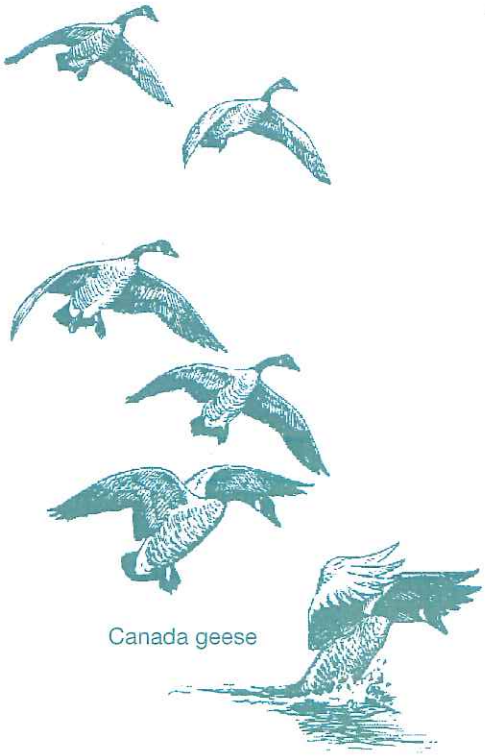
Field guides are available at most bookstores.

FOR MORE INFORMATION

Numerous publications on wildlife and other topics are available through Penn State. Call 800-235-9473 to request a list of free publications or visit **ecosystems.psu.edu/extension/publications**.

Red fox



This publication was prepared by Kristi L. Sullivan, wildlife biologist, and Margaret C. Brittingham, professor of wildlife resources, Penn State College of Agricultural Sciences.

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The Forest Stewardship Program is administered nationally by the USDA Forest Service and is directed in Pennsylvania by the DCNR Bureau of Forestry with assistance from a statewide steering committee. The Forest Stewardship Program assists forest landowners in better managing their forestlands by providing information, education, and technical assistance. For more information about program services, contact the Pennsylvania Forest Stewardship Program, DCNR Bureau of Forestry, PO Box 8552, Harrisburg, PA 17105-8552; phone: 717-787-2160. For more information about publications, contact the Pennsylvania Forest Stewardship Program, Department of Ecosystem Science and Management, 416 Forest Resources Building, University Park, PA 16802-4705; phone: 800-235-9473.

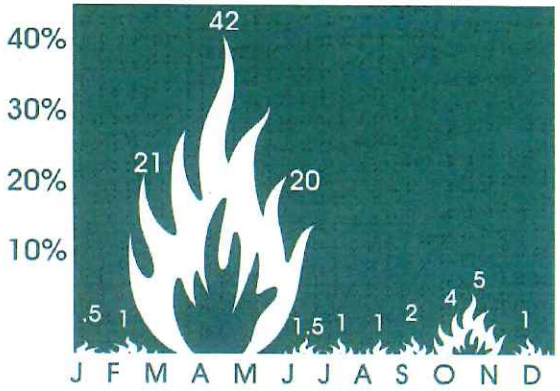
Wildfire

In the world of the professional fire fighter, the term "wildfire" has replaced the term "forest fire." "Wildfire" is more descriptive of the wild, uncontrolled fires which occur in fields, grass and brush as well as in the forest itself. A stray spark can often ignite dried grass more easily than it can start a fire in the dried leaves of the forest floor. Once started, grass and brush fires can spread to adjacent forested land.

Brush and grass lands are an important part of the Commonwealth's natural resources. They support many types of wildlife and some types of recreation, Grass and brush are also soil stabilizing ground cover which help to protect valuable soil from erosion. Frequently, these areas of low growing plants are the first stages in development of a future forest.

Most people believe the greatest danger of wildfire occurs during the summer. The large. dramatic wildfires burning in the western states draw attention from the national news media. Due to the dangerous conditions created by these large fires and the threat to life and property, the national fire prevention television campaign is in the summer.

Percentage of Wildfires occurring each month.



These campaigns have led most people to believe that Pennsylvania is most vulnerable to wildfires in the summer as well. Actually, our greatest danger of wildfires is in the spring months of March, April and May, and the autumn months of October and November. Another important difference between western wildfires and those in Pennsylvania is that a large percentage of the western fires are caused by summer 'dry' lightning storms. In Pennsylvania lighting-caused fires are relatively rare. ***Ninety-eight percent of our wildfires are caused by people.***

Why spring and fall months?

Certain conditions are necessary for a wildfire to occur.

ONE...An available fuel source, such as grasslands or fields.

TWO...Dry conditions, including the fuel source.

THREE...An ignition source — some way for the fire to start.

The first two factors occur most frequently in Pennsylvania during the spring and autumn. As winter slowly recedes and the sun climbs higher in the sky, the days become longer and warmer. The trees are bare during this time allowing the sunlight to reach the forest floor warming the ground and drying last fall's leaves.

This, coupled with the fact that the winds in the spring are often very strong and dry, leads to a tremendous amount of fuel ready to burn.

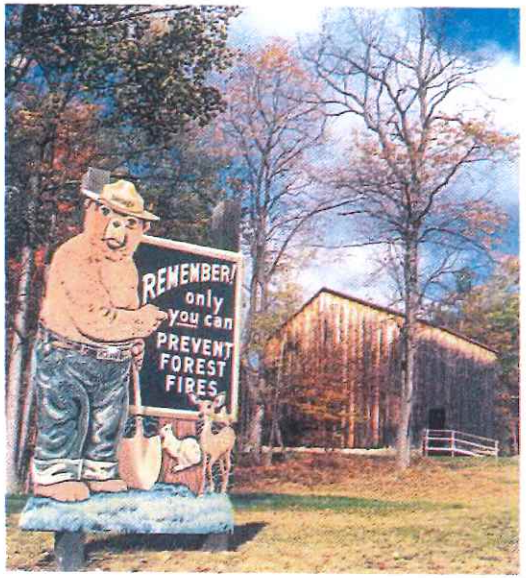
During the fall, starting around October, the leaves turn color and begin to fall, accumulating in a deep fluffy layer that creates a fire hazard.

The third factor, ignition source, also occurs during these periods. *One of the major causes of forest fires in Pennsylvania is debris burning.* A careless person burning accumulated trash can be responsible for causing thousands of acres of valuable Pennsylvania forests to burn. These fires most frequently start in someone's backyard and travel through the dead grass and weeds into the bordering woodlands.

Always be careful with fire!

Regardless of the season, conditions often prevail that allow wildfires to start. Wildfires can occur in any month, at any time of the day, destroying valuable woodlands and wildlife habitat. Homes and buildings are threatened, not to mention the direct threat to human lives.

Wildfires can be prevented! The majority of forest fires in Pennsylvania can be stopped before they happen by being careful with the use of fire.



In the series: ***Getting Started with Forestry***

Just Say No to High-Grading, Selective Cutting, and Diameter-Limit Cutting

Peter J. Smallidge - State Extension Forester, Cornell Cooperative Extension, Department of Natural Resources, Cornell University, Ithaca
and
Michael C. Greason - Chief (retired) of the Bureau of Private Land Service, New York State Department of Environmental Conservation, Albany, NY

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Currently the prices paid for timber in New York woodlots are good and harvesting activity has increased. However, what may surprise many forest and woodlot owners is that some forestry techniques can limit options for future benefits and enjoyment -- both in the long run and short term. While well-planned timber harvesting can increase your benefits, "high-grading" and related practices should be avoided.

Cutting the best trees (those of highest value) and leaving the low value, often diseased or malformed trees, is too common. This type of forestry is called high-grading, where the highest grade (or value) trees are removed. By cutting only the largest and most valuable trees you remove those best suited to that site. The trees that are less well adapted remain as the next forest and the seed source for future forests. The financial gain of high-grading exist only briefly, yet ownership objectives can be sacrificed for decades. A similar analogy from livestock is the farmer or stable manager who shoots the blue ribbon bull or winning race horse and uses the losers for breeding stock. The quality of the herd, just as the quality of the forest and woodlot, declines rapidly!

In addition to high-grading, similar practices exist with different names. High-grading is often disguised under the name of "diameter-limit cutting". This is a practice that removes all trees above a certain minimum diameter. In some rare situations diameter-limit cutting is appropriate. For example, if old pasture trees are shading the growth of young hardwood saplings. Often however, diameter-limit cutting removes trees of commercial value (say above 12 or 14 inches in diameter) before these trees can attain a more valuable size and add seed and seedlings to the forest. Selective cutting is another technique where high-grading can occur. Selective cutting (generally not recommended) differs from the selection system of silviculture (a legitimate technique). Selective cutting, as commonly practiced, involves selecting the highest quality trees and cutting them. (Technical note: selective cutting by definition can include other activities such as improvement cuts) The selection system involves someone professionally trained in silviculture to select trees from all age and size classes, both high and low quality to produce an uneven-aged forest. Diameter-

limit cutting and selective cutting are often rationalized by arguing to remove the bigger trees so the smaller trees can grow. However, the smaller trees may be undesirable species, poor form, or poor health. By any name, high-grading degrades the value of the forest regardless of the "logic" used by foresters or loggers trying to make a quick buck.

Why does high-grading happen? A common cause for high-grading is greed to maximize immediate profits. Beginning in the early 1970's, demand for high-value timber increased and sawmills could pay more for certain species. Thus, markets for high-value trees grew stronger while markets for low value trees did not. Further, it costs about the same amount of money to cut and haul a $10 tree as it does to cut and haul a $300 tree of the same size. Another factor is that taxes on forest land not under the NYS 480-a Forest Tax Law can create financial hardships that encourage landowners to maximize immediate profits. The result is that more immediate profit is gained by cutting only the highest value trees, but left behind is a legacy of low quality trees and under-productive forests. This knowledge helps explain high-grading, but doesn't excuse it.

What are the consequences of high-grading, is it really that bad? One result is that the trees that are left behind won't grow as quickly as better quality trees and the time until the next harvest is lengthened. In addition, the next harvest will remove the low quality trees previously left so the value at the next harvest will be reduced. If you magnify the practice of high-grading across a region, assuming the demand for wood products remains steady, then more acres must be harvested to meet the demand. While timber harvesting is not bad, accelerated harvesting is not in the best interest of our natural resources and conflicts with a growing demand by the public for accountability of natural resource management. As the value of the land to produce timber crops decreases, the incentive to subdivide and develop increases.

So what can you do to avoid high-grading? One step is to work with competent and professional loggers and foresters. When you select a new refrigerator or car you likely consider several features, including price, reputation, service after the sale, and other long-term benefits. Similarly select your forester and logger. Ask for references, find out if the forester participates in continuing education programs and whether the logger has completed the "Trained Logger Certification" program, make a visit to forests or woodlots where they have worked, and know that the best price may not provide the best treatment for your land. The logger who out bids his competitors for a timber sale by a few percent may be more efficient or may not devote enough effort to ensure your property is left in good condition. Similarly the forester who promises you maximum short-term profit likely doesn't have in mind the best interests for you and your land. The consequences of selecting an incompetent forester or logger will exist longer than a bad choice on a refrigerator.

Another step to avoid high-grading is to have a written management plan. Your management plan will state your objectives and help keep you on track. The harvesting schedule in your management plan will help you decide when harvesting is appropriate. Just because a forester or logger offers to cut your timber doesn't mean it's the best time for your interests. The value of trees increases greatly as trees get bigger, and it's probably a safe assumption that good markets will continue to exist for high quality trees (although markets fluctuate).

Third, look for creative solutions to remove the low value trees at the same time the high value trees are harvested. A harvest that removes high-value and low-value trees provides financial benefits from the high- and low-value trees and improves the quality of the residual forest. One way is to have the forester mark and the logger skid the low value trees to the log landing. Then you can cut them

yourself for firewood, or sell them to a firewood processor. This will require extra effort on the part of the logger and forester, which means you might not make as much money, but the benefits, including even greater profits, will exist a few years down the road.

Finally, get assistance from unbiased people to help you develop long-term objectives and management plans. Master Forest Owner Volunteers are forest owners trained through Cornell Cooperative Extension to provide nontechnical assistance to forest owners. They can help other you think through your management objectives and provide sources of information. Also, NYS Department of Environmental Conservation professional foresters are available for free consultation and can provide technical expertise and guidance on forest management. Both of these groups of people can provide free, unbiased information and advice that will help you avoid some of the pitfalls of practicing short-sighted forestry. The Catskill Forest Association and New York Forest Owners Association are landowner groups dedicated to helping other landowners enjoy their forest land. Contact your county office of Cornell Cooperative Extension or the nearest DEC office for more information.