ENHANCEMENT OF WILDLIFE HABITAT ON PRIVATE LANDS

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PREFACE

We often receive requests from people for information about activities they could do to increase the number and variety of wildlife on their lands. Fortunately, there is a great deal of information on this subject. Some activities have been recommended and used for decades. Others are not so well known but have proved effective. Unfortunately, materials for most activities are scattered in circulars and leaflets from a variety of agencies and organizations.

Our purpose in this bulletin is not to present newly developed techniques but to select from among existing activities those we have found most appropriate for the majority of interested landowners. Activities were selected that have low to moderate costs and time commitment but have been proven effective. We have seen our role in preparing this bulletin as that of compilers rather than creators, selectors rather than developers. We have tried to make the instructions and illustrations as easy as possible to follow and understand. We have also tried to present a balanced look at both the positive and negative aspects to consider before becoming involved in increasing wildlife populations. We hope the outcome is a valuable, easy-to-use set of instructions for projects to enhance species of native wildlife and to increase your opportunities to enjoy them.

INTRODUCTION

Have you ever wondered what *you* could do to help your local wildlife populations? Many people who at one time or another have wanted to spend some of their spare time improving living conditions for wildlife on their land have not done so because they were not sure what to do, how to do it, when to do it, or if it would do any good. Many people are fearful that their efforts might unintentionally harm wild animals. Consequently, they do little or no work to improve wildlife habitat on their lands. In truth, generally wildlife management is compatible with other objectives such as sawtimber management (see reference 12).

This failure to act is unfortunate because the hundreds of thousands of landowners, their families, and their tenants in New York could have a tremendous influence on the future of wildlife in the state. The vast majority of wildlife habitat in New York is on private lands, whether one or a thousand acres. The future of wildlife will be determined by how these lands are managed. Whether deer, rabbit, songbird, or owl will flourish or diminish over the next few decades is largely at the discretion of these landowners.

Much of the rural land of New York State (similar to much of the northeastern United States) is in transition from agricultural use to naturally occurring brushlands or residential development. Agricultural lands abandoned in the early 1900s are now covered by pole- or small sawtimber-sized stands. The rapid decline of acreage in active farmland and open grasslands and shrublands has resulted in a direct decline of populations of wildlife species dependent on such habitat for part or all of their life needs. Another phenomenon in the Northeast is the regional fragmentation of contiguous forest stands by urban and suburban development, resulting in declining populations of wildlife species that are dependent on large mature forest stands.

The decline of wildlife species associated with open land and large forests is a prime focus of a relatively new wildlife management concept called "ecosystem management." This holistic approach considers habitats on an ecosystem basis, often encompassing thousands of acres. The focus is on management of assemblages of wildlife rather than individual species. A primary tenet of ecosystem management is the protection of biological diversity (biodiversity), defined as "the variety of life and its processes and including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur." The geographic and time scales of management are enlarged over traditional approaches to include landscapes and decades. Such an approach frequently includes hundreds of individually owned parcels and extends well beyond the tenure of current landowners.

Although no one landowner can practice ecosystem management, collectively the five hundred thousand owners of forest land in New York State can have a tremendous impact. Wise management decisions made by individual landowners can contribute significantly to the overall well-being of wildlife throughout the ecosystem. We will refer to the concepts of ecosystem management and biodiversity as appropriate throughout the bulletin (see reference 29).

Fortunately, most people owning or living on rural lands care a great deal about the wildlife that also live on or visit their property. Most of these people are willing to help enhance wildlife habitat as best they can within the limits of their time and financial resources.

The purpose of this bulletin is to aid landowners in their efforts to improve wildlife habitat. We have selected from many sources ten time-tested projects that landowners could easily undertake to help wildlife. They can be conducted at little cost and with a minimum of equipment; ordinary tools such as a shovel, ax, bucksaw, chain saw, and hammer and nails are usually all that are required. The projects are designed to encourage a variety of birds and mammals. Step-by-step instructions, including illustrations, are provided for each project, and the projects are numbered for easy reference.

Many of the projects are equally applicable for an urban park or a suburban backyard, as well as for the "back forty" on a rural farm. Individuals, families, communities, and youth groups can do these projects.

Readers seeking more complete discussions of wildlife ecology and wildlife management principles are encouraged to review the publications listed in the "Helpful References" section of this bulletin.

BENEFITS OF WILDLIFE ENHANCEMENT

You can enjoy many benefits from improving wildlife habitat on your land and around your home. The most obvious will be increasing the opportunity for you and your family to view or possibly study the various birds and mammals you attract or help produce. For some people this may be reason enough to undertake the projects outlined in this bulletin. Others may also enjoy hunting and eating wild game, and improving habitat for such wildlife will increase these opportunities, too.

Carefully thought-out wildlife projects can be useful to people in other ways. For instance, an increase in some insectivorous birds around your garden may reduce insect damage to garden produce. Maintenance of snags near your garden may encourage birds of prey to perch there and help protect your vegetables from cottontails and rodents. Placement of kestrel nest boxes may similarly help control small rodents. Building bat roosts may result in fewer mosquitoes around your yard.

POTENTIAL PROBLEMS YOU SHOULD CONSIDER

Because wildlife can cause problems for you or your neighbors, you should give some thought to this possibility before trying to encourage various birds and mammals in your area. You need to think beyond your own property.

For example, you might decide not to place a brush pile along your property boundary if your neighbor's garden is close by. Although you may be willing to house a family of cottontail rabbits, your neighbor may not be so eager to feed them.

Your plans could backfire, too. You might be annoyed if your efforts to attract squirrels (by placing nest boxes and feeding them) during spring, summer, and fall are so successful that a few take up residence in your attic over the winter. For more insight concerning the potential problems commonly associated with birds and mammals and ways to alleviate these problems, see *Control of Wildlife Damage in Homes and Gardens* (Cornell Information Bulletin 176) by J. W. Caslick and D. J. Decker.

FIGURE 1. Wild rabbits in the garden may cause problems.

ELEMENTS OF WILDLIFE HABITAT

Wildlife managers have recognized for some time that the health, or thrift, of wildlife populations is closely linked to four primary factors: food, cover, water, and space. These elements make up an animal's *habitat*. The projects presented in this bulletin may influence the first three elements. Space is more difficult to alter, although an animal's requirement for space may substantially diminish as food, cover, and water are made more adequate in smaller areas.

The amount and variety of food, cover, and water (that is, the quality of the habitat) determine the carrying capacity of the land for a species. The term *carrying capacity* is often used to refer to the maximum number of animals of a species a unit of land can support during the most unfavorable time of the year. This number is not constant. The carrying capacity of an area of land fluctuates in response to environmental influences on it, natural or human-induced.

Cover is a vague term used generally to mean protection available in an animal's habitat. Cover may be a brush pile for a rabbit, a nest box for a wood duck, or a spruce tree for a golden-crowned kinglet. Regardless of form, cover provides for one or more of the necessary functions in the lives of animals: breeding, nesting, hiding, loafing, sleeping, feeding, and traveling.

Food, of course, is required by all wildlife. All animals must eat other animals or plants to survive. If your land is devoid of desired animal species that are otherwise native to your area, it might be because food resources are inadequate. Sometimes food plants also serve as cover (for example, shrubs for rabbits), or cover plants may provide a forage base for other food items (such as insects on tree foliage). Sometimes food and cover are in different locations. When this occurs, an important management strategy may be to provide food near cover or vice versa. Areas that provide different cover functions and areas that supply different food sources can often be connected via travel corridors (see Project 10).

Water is an essential requirement for all wildlife, though not all animals need standing water. For those requiring it, a creek, spring, small pond, or even an artificial fountain or birdbath serves the purpose. One must be careful to provide for the year-round water needs of wildlife.

Often creating the correct arrangement, or juxtaposition, of food, cover, and water is a key to making your property attractive to wildlife. Keep this in mind when reviewing the projects in this bulletin and picking the combination of projects to meet your objectives for wildlife on your property.

FIGURE 2. Ordinary tools can be used to enhance wildlife habitat.

CHOOSING A PROJECT

Several criteria could be used to select a wildlife enhancement project. Your decision will be based on what habitat component (food, water, cover) is needed when deciding which of the ten projects you are capable of undertaking.

You must first set some objectives. These may be species-specific, such as to increase the number of bluebirds nesting on your property or to increase the frequency with which wild turkeys use your property. Or you may set more general objectives such as to increase the frequency with which migratory songbirds use your property. In all cases, you need to identify any *limiting factors*. A limiting factor is the habitat component that is missing or limited to the extent that if that component were provided or enhanced, there would be a direct increase in a species' population or in its use of an area of land.

For example, the limiting factor for bluebirds often is suitable nesting sites. The construction of nest cavity boxes will often fill this critical need. In the case of wild turkeys, a limiting factor may be sufficient brood rearing range, which for turkeys is grasslands that provide an abundant supply of insects for the poults to eat. In all cases, however, you must become familiar with the life cycle and history of species you are interested in. References 13, 14, 15, and 26 are good sources of such information.

After having decided which potential habitat needs to address, you must decide whether they match your capabilities. Depending on your goals, you may want to choose a project in which your whole family could be involved, or you may pick one because it is most compatible with some other activity under way on your land.

To help you choose a project, we have prepared two tables. Table 1 lists six criteria:

TABLE 1. Guide to selection of wildlife enhancement project, based on project characteristics

		Project number									
Criteria		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Location	Around the house					x	x	x	x		
	Backyard			x	x	x	x	x	x		x
	Woodlot	x	x	x	x	x	x	x	x	x	x
	Fields and other open areas	x	x	x		x	x	x	x		x
Action	Plant								x		x
	Dig							x	x		x
	Cut	x	x	x		x	x	x	x		x
	Build	x				x	x	x			
	Do nothing (passive)				x				x		x
Wildlife habitat needs supplied	Food		x	x	x		x	x	x	x	x
	Cover	x	x		x	x	x	x	x		x
	Water							x			
Cost	Low	x	x	x	x			x	x	x	x
	Medium					x	x	x	x	x	x
	High							x	x	x	
Time commitment	Low	x	x	x	x			x	x	x	x
	Medium					x	x	x	x	x	x
	High								x		
Longevity or durability	Low								x	x	x
	Medium	x	x	x				x	x	x	x
	High			x	x	x	x		x		x

TABLE 2. Guide to wildlife species enhanced by each project for selected species

		Project number									
Wildlife species enhanced		*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Mammals	White-tailed deer		x	x				x	x	x	x
	Cottontail rabbit	x	x	x				x	x	x	x
	Gray squirrel			x	x	x	x	x	x		x
	Foxes			x							x
	Raccoon			x	x	x		x	x		x
	Skunk	x	x	x					x		x
	Mink	x	x					x			
	Weasels	x	x								
	Chipmunk	x	x	x	x		x		x		x
	White-footed mouse	x	x	x					x		x
										x	
Birds	Wild turkey		x	x			x	x	x	x	x
	Ruffed grouse	x	x	x				x	x	x	x
	Woodcock			x						x	x
	Ring-necked pheasant			x			x	x	x		x
	Owls				x	x				x	x
	Hawks				x					x	x
	Wood duck				x	x			x		
	Chickadee				x		x		x	x	x
	Cardinal						x		x	x	x
	Bluebird				x	x			x	x	x
	Mourning dove						x	x	x		x
	Wren	x	x		x	x				x	x

location, action, wildlife habitat needs supplied, cost, time commitment, and longevity or durability and rates each project in this bulletin for each criterion. These should help you decide which project(s) to undertake based on your personal evaluation of the criteria.

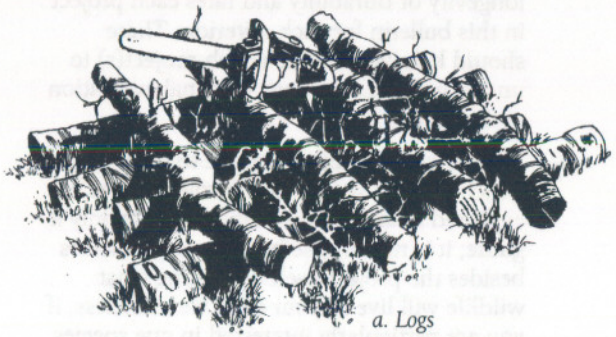
Table 2 can be used as a guide to determine which wildlife species each project might be expected to attract or enhance. This is only a guide; it is not precise because many factors besides the project itself determine what wildlife will live in your area. Nevertheless, if you are particularly interested in one species of bird or mammal, Table 2 will help you pick out the project(s) most likely to enhance that species. Once you have chosen a project that seems suitable, you simply need to turn to the page where instructions and illustrations for that project begin. At the end of the description of each project is a list of reference numbers to works listed in "Helpful References" related to that project. You might want to obtain these before starting work.

As you are considering your wildlife enhancement project, we would urge you to learn as much as you can about the wildlife species you wish to help. This will not only add to your enjoyment, appreciation, and understanding of these resources but will also help you do a better job with your project.

Above all, be realistic in your expectations. Work with species that are common to your area and do not expect overnight results. Time is an important factor in attempting to influence population levels of any wildlife species.

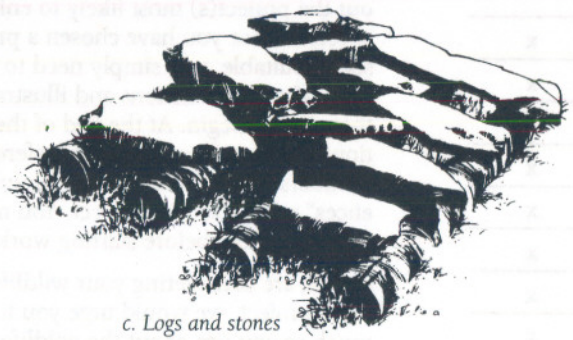
Remember, it is better to undertake a small project and execute it well than to attempt too much and not be able to see it through to a successful conclusion.

FIGURE 3. Types of bases for brush piles

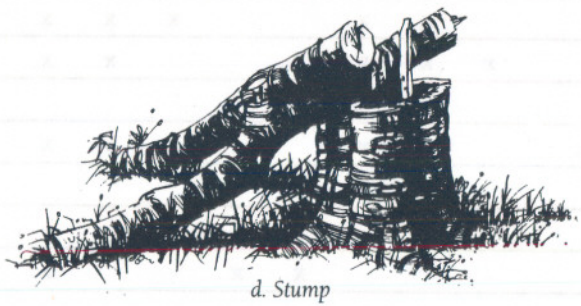


a. Logs

b. Stones

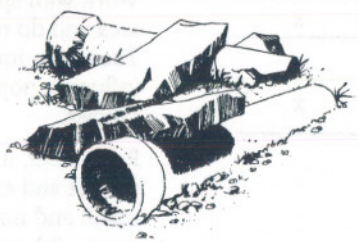


c. Logs and stones



d. Stump

FIGURE 4. Tiles under brush piles provide a ready-made burrow.



Brush shelters serve primarily as cover for wildlife. Many species of small mammals use this type of cover when available, but brush piles are especially important to cottontail rabbits. Properly constructed and located brush piles are heavily used by cottontails as resting and escape cover. (See Project 5 for directions on how to build an artificial rabbit burrow that could be placed beneath the brush pile.)

At first, it may seem that building a brush pile is so easy that no instructions are needed. It would seem to be simply a matter of throwing an armful of brush (crowns and limbs of felled trees or shrubby growth) in a pile. But wildlife biologists have found that if certain construction specifications are followed when building brush shelters, rabbits are more likely to use them. To build a base for the brush shelter, use

a) 4 poles 6 feet long and 4–8 inches in diameter, placed parallel to each other on the ground 8–12 inches apart. Then place 4 more poles of the same size perpendicularly across the top of the first 4 poles.

b) stones 8–12 inches in diameter, placed in 3 pie-shaped groups such that the spaces between the groups form a Y.

c) 3 or 4 poles 6 feet long and 4–8 inches in diameter, placed parallel to each other on the ground 8–12 inches apart. Then, place large, flat rocks across the top of these.

d) if these other bases are not possible to make, use a stump as a base to raise the shelter off the ground in the center.

Any of these bases will work well. They serve to keep tunnels open under the pile once the brush is stacked on top. A slightly more elaborate design uses a 3-feet-long piece of 4–6 inch tile, slightly buried at the far end (the end farthest into the brush pile). This creates a ready-made burrow for a cottontail rabbit.

After the base of the brush shelter has been built, you can add the brush. Start with larger (stouter) limbs first and then gradually add smaller pieces. The pile should be about 6–8 feet high, or higher, and of about the same diameter.

FIGURE 5. Brush pile construction starts with heavy branches and is topped off with small branches.

FIGURE 6. Locate brush piles near food sources; distribute the brush piles around your forest clearing.

Brush piles should be located near feeding areas, along field borders, or interspersed at reasonable intervals in overgrown fields. Such placement will provide the cottontails relatively safe access to more food and, in essence, increase the amount of space available to them. Do not locate a brush pile at the base of a tree or snag; this creates a perfect setup for a hawk or owl to ambush a rabbit if it strays from the sanctuary of the brush pile.

Brush shelters can be a beneficial by-product of thinning or timber-cutting operations in a woodlot. Consider making brush piles if you are involved in any land-clearing activities, such as when building a road, clearing a field, or cutting back woody growth in and along a pasture.

Sources of information on brush pile construction: 8, 9, 22, 31, 42.

2. Living Brush Piles

Like the brush shelter described in Project 1, living brush piles provide shelter for a variety of small mammals. But living brush piles also provide food. Those made of hardwood species may supply buds, twigs, and foliage for several years for wildlife such as white-tailed deer, cottontail rabbits, ruffed grouse, and wild turkey. Because insects use brush piles for harborage and eat the foliage, the piles also benefit many species of songbirds that forage for insects.

You can make living brush piles from a conifer or several deciduous trees. Partially cut through a branch or stem, leaving as much of the bark intact as possible. The layer just under the bark is the "bloodstream" of the tree; if not completely severed, it may keep the tree alive for some time. But the tree's (or affected limbs') vigor is greatly diminished, and because the cut portions are exposed to disease, the tree will die after a few years.

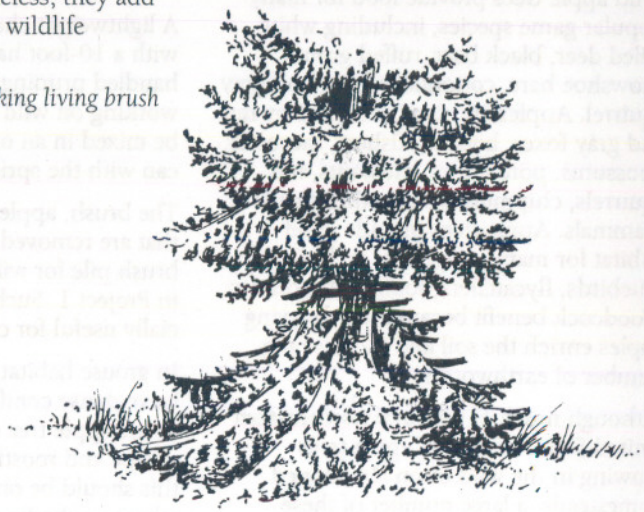
Living brush piles can be made by using a group (preferably six or more) of deciduous saplings 6–10 feet in height. These can be cut partially through at a height of 6–10 inches and toppled over toward one another (Fig. 7a). This creates a dense growth in following years. When the saplings eventually die, they can be cut through completely and used to construct a brush pile such as described in Project 1.

A living brush pile can also be made by cutting partway through the lower limbs of a conifer that has limbs low on the trunk (Fig. 7b). The first two or three whorls of branches should be sliced and pushed down forming a "teepee."

A drawback of living brush piles is that they can be located only where appropriate trees are found. Nevertheless, they add a valuable dimension to the wildlife habitat on your land.

Sources of information on making living brush piles: 9, 12, 31, 42.

a. Hardwood saplings



b. Lower limbs of a conifer

FIGURE 7. Living brush piles

3. Release and Care of Wild Apple Trees

Wild apple trees are among the most valuable wildlife food that we have. They are commonly found on rural lands where they provide food for a wide variety of wildlife. The apples, leaves, buds, twigs, and even the bark may be used by various birds and mammals over the course of a year.

Wild apple trees provide food for many popular game species, including white-tailed deer, black bear, ruffed grouse, snowshoe hare, cottontail rabbit, and gray squirrel. Apples are also consumed by red and gray foxes, bobcats, fishers, raccoons, opossums, porcupines, muskrats, red squirrels, chipmunks, and other small mammals. Apple trees provide good habitat for many songbirds, including bluebirds, flycatchers, robins, and orioles. Woodcock benefit because the decaying apples enrich the soil and increase the number of earthworms.

Although much of the rural northeastern United States has many apple trees growing in the wild or on abandoned homesteads, a large number of these important wildlife food plants are lost each year. You can help prevent this unfortunate trend by following the procedures outlined in this project.

Wild apple trees typically become established in or along the edges of forest clearings and abandoned fields. As the other forest trees grow in these areas, the apple trees are crowded by shrubs and shaded by larger, overtopping trees. Similarly, in abandoned apple orchards, forest tree species eventually invade and dominate the site.

After prolonged periods of crowding and shading, the vigor of these apple trees is diminished so that they eventually die and are lost to wildlife. The life span, health, and productivity of these apple trees can be improved by applying some simple techniques commonly used by foresters and orchardists. The step-by-step procedure we recommend is given on page 13.[1]

A lightweight chain saw, a pruning saw with a 10-foot handle, an ax, and long-handled pruning shears are useful tools for working on wild apple trees. Fertilizer can be mixed in an ordinary pail or watering can with the sprinkler head removed.

The brush, apple tree branches, and trees that are removed can be piled to form a brush pile for wildlife cover, as described in Project 1. Such brush piles are especially useful for cottontail rabbits.

In grouse habitat, it may be helpful to leave dense conifer or brush growth close to the apple tree on one side to provide escape and roosting cover. Where possible, this should be on the north side of the tree where its shading would least affect the apple tree.

If there are very large trees to be removed, it may be faster and safer to girdle the trees and leave them standing. Girdling is accomplished by cutting completely through the bark in a ring around the tree. This may not be desirable if the tree to be removed has timber value. The dead standing tree may serve as a valuable snag for cavity-nesting birds (see Project 4).

Spraying the cut stump of trees and brush with chemical herbicides retards sprouting, although such sprouting may produce good deer browse. Do not use chemical sprays on apple tree stumps because they may be connected to the roots of the tree you wish to save.

The effects of fertilizing last approximately three years, but to promote maximum growth, the tree can be fertilized every year.

The area within the drip line of an apple tree should be cleared of brush. Most species of wildlife benefit from clearings in brushy or wooded areas and would benefit from larger clearings around apple trees, if this could possibly be accomplished.

Sources of information on release and care of wild apple trees: 6, 9, 41.

[1]The procedures described herein are largely adapted from New Hampshire Cooperative Extension Service Folder 70 and are used with permission.

FIGURE 8.

STEP 1.

Carefully examine the apple tree. Look for dead branches, diseased wood in the trunk, and the presence of more than one stem (trunk). If there is more than one stem, select the largest and most vigorous and remove the smaller competing stems by cutting them off as near the ground as possible. If the largest stem is badly diseased or broken, remove it and select the next largest, most vigorous stem for improvement.

STEP 2.

Remove all other shrubs and trees back to the drip line of the apple tree crown. If the tree is shaded by large overtopping trees, remove these on at least three sides, especially toward the south. Defer total release for a couple of years if badly overtopped as too much sun may kill the tree. Remove all the dead branches from the apple tree. Cut them off with a pruning saw or pruning shears as close to the living branches as possible.

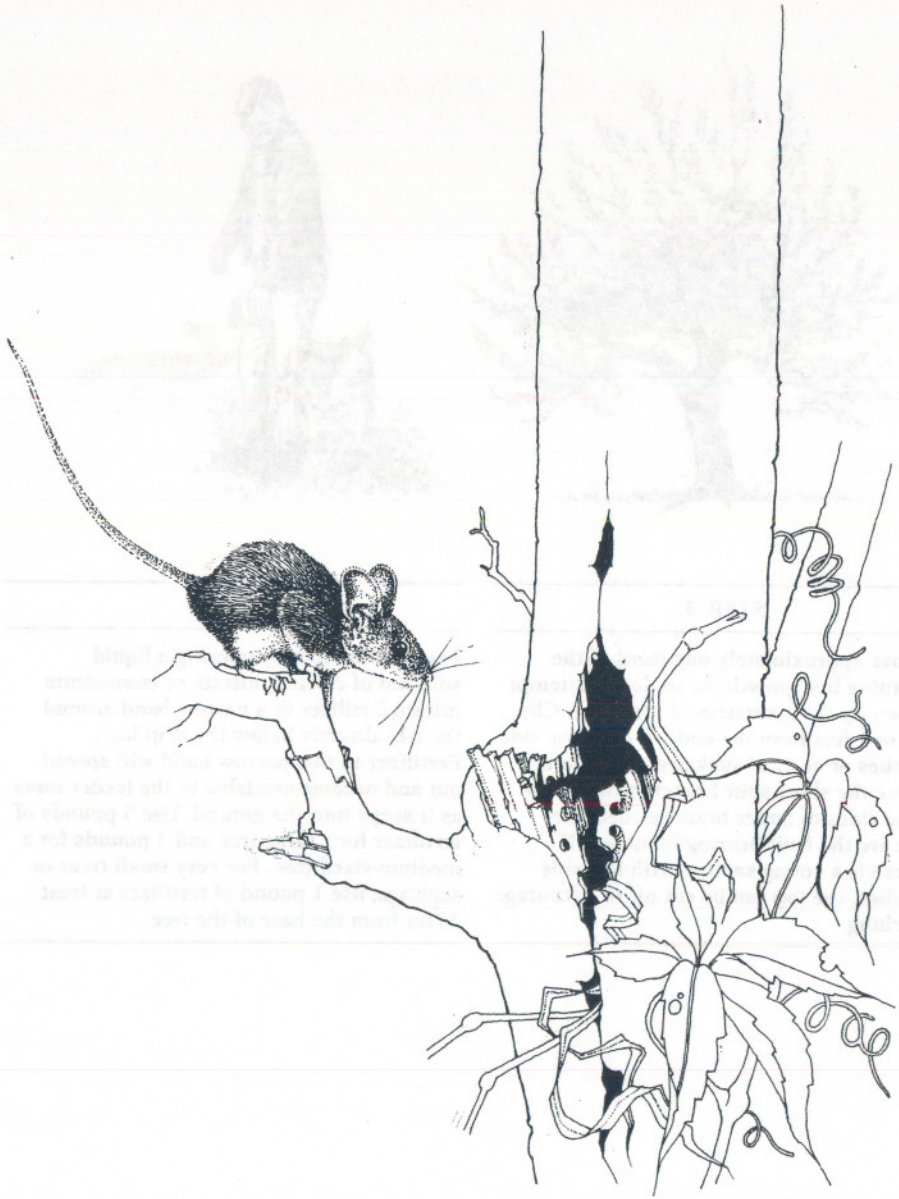
STEP 3.

Remove approximately one-third of the remaining live growth. In so doing, attempt to open up thick clusters of branches. Clip off 1 to 2 feet from the ends of vigorous side branches or vertical sucker shoots. Do not remove the short spur branches that grow on the sides of larger branches because these are the fruit-bearing branches. If the tree is a young sapling with few side branches, the top can be cut off to encourage branching.

STEP 4.

Fertilize the tree by pouring a liquid solution of calcium nitrate or ammonium nitrate fertilizer in a narrow band around the tree directly below the drip line. Fertilizer in this narrow band will spread out and become available to the feeder roots as it seeps into the ground. Use 5 pounds of fertilizer for a large tree and 3 pounds for a medium-sized tree. For very small trees or saplings, use 1 pound of fertilizer at least 3 feet from the base of the tree.

FIGURE 9. Snags attract a variety of wildlife.



Many species of birds and mammals prefer or require cavities in dead or diseased trees for nesting and shelter.[2] The scarcity of nesting and roosting cavities is a major factor limiting the populations and diversity of many cavity-nesting birds. Some cavity-nesting birds such as woodpeckers excavate their own nest holes. These birds are called primary hole nesters. Others, like the wood duck, kestrel, and screech owl, are secondary hole nesters—they use cavities previously excavated by another bird. Many mammals simply take advantage of hollowed sections of trees that have rotted out.

Snags

Snags are dead trees that are still standing. Snags are used primarily as nesting, feeding, or perching sites. Until recently, foresters systematically removed snags because of their potential for harboring disease and insect pests. This trend is changing. It now is widely recognized that many bird species that nest in snags feed heavily on insects and thereby help to prevent serious insect outbreaks. Other snag nesters such as squirrels are prey for human hunters and wild predators. After a tree dies, the slow process of decay begins. As the heartwood softens, woodpeckers excavate nesting and roosting cavities in a snag. After they abandon these cavities, other wildlife may use them. Wildlife may nest in live trees, but they often choose diseased, decadent, or dying trees.

Not all snags are equal in quality or suitability for providing nesting habitat for birds.[3] Basswood and birch are good cavity-producing trees, but most oaks (except black oaks) are not. Small diameter trees may be suitable for some birds but not for larger wildlife. Short-lived tree species such as aspen often provide suitable snags before other forest trees mature. Trees infested with fungal heart rot often provide suitable cavities sooner than do sound trees through the natural death and decay process. Trees notorious for heart rot, such as beech, should be considered as potential nest trees.

Snags are classified as either hard or soft. Soft snags are punky and weak. Though they are excellent foraging areas, soft snags are neither as long lasting nor as good for nesting as are the sturdier hard snags.

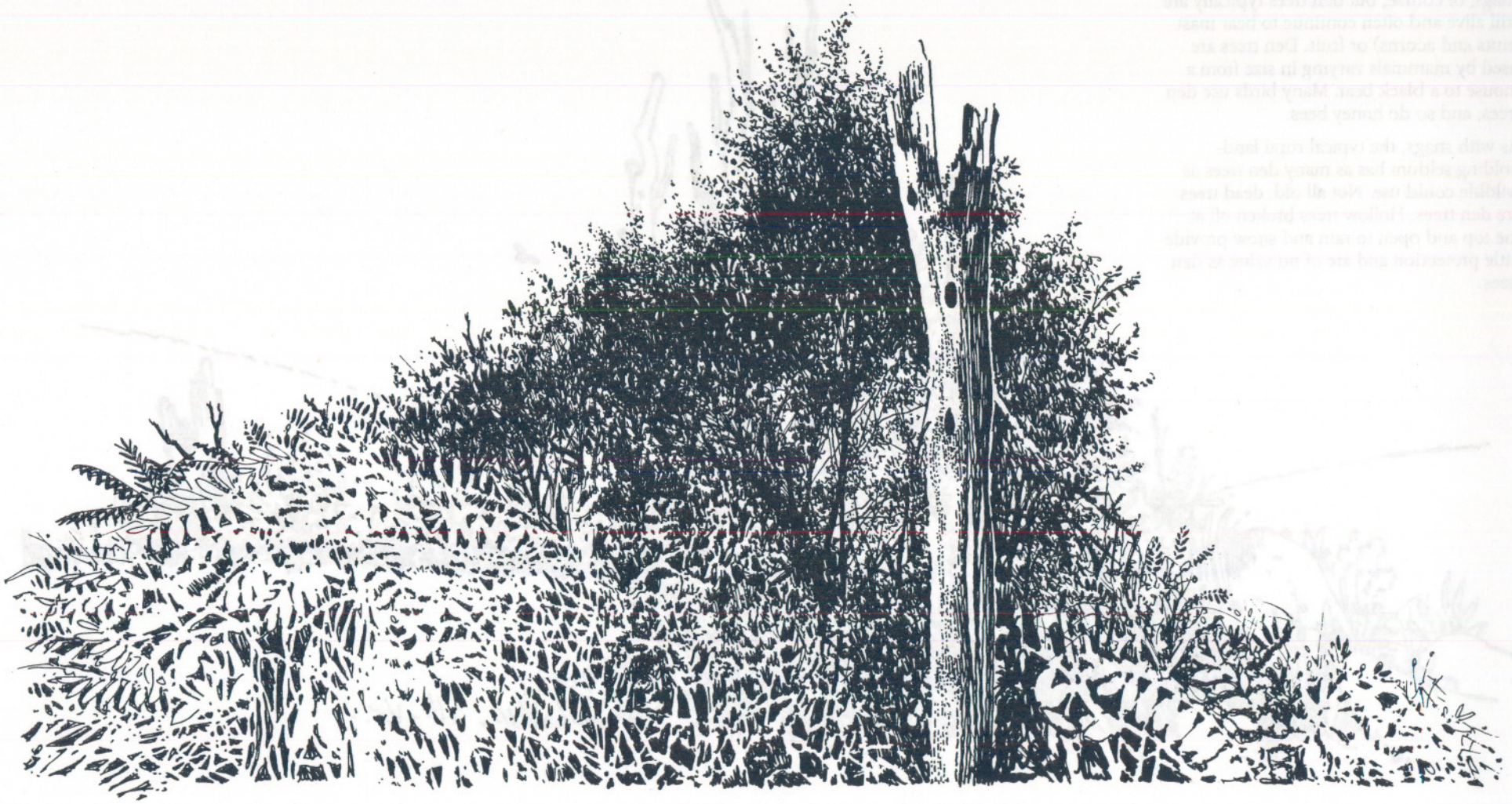
Snags should not be removed indiscriminately in forestry or firewood cutting operations. If some snags must be removed, you should not take the tallest or largest. Maintain no less than three hard snags (or live trees with heart rot) and two soft snags per acre. Preferably, you should try to maintain in your woodlot for each 2.5 acres two snags over 18 inches DBH,[4] three to four snags over 14 inches DBH, and five to six snags over 6 inches DBH. Some large decadent trees that are potential snags should be retained as well. Snags that present a safety hazard should be removed.

[2]See Gutiérrez at al. (1979:27–29) for a list of birds and mammals that commonly use tree cavities.

[3]See Gutiérrez et al. (1979:30, Appendix 3).

[4]DBH = diameter at breast height (4.5 feet).

FIGURE 10. Snag



Den Trees

Den trees are those in which the trunk or large limbs have been hollowed out by rotting and there is an opening to the outside. This category includes some snags, of course, but den trees typically are still alive and often continue to bear mast (nuts and acorns) or fruit. Den trees are used by mammals varying in size from a mouse to a black bear. Many birds use den trees, and so do honey bees.

As with snags, the typical rural land-holding seldom has as many den trees as wildlife could use. Not all old, dead trees are den trees. Hollow trees broken off at the top and open to rain and snow provide little protection and are of no value as den trees.

FIGURE 11. Snags provide nesting, feeding, and perching sites for birds.

FIGURE 12. Den tree

Wolf trees—large, spreading trees—are likely to be den trees. They also tend to produce more mast or fruit than others, making them doubly valuable for wildlife. Some den trees have round openings on the trunk where a dead limb has fallen off. Others have an opening at the base of the tree. As many den trees as possible should be kept intact in a woodlot or along a hedgerow.

Creating Snags and Den Trees

Most areas do not have enough snags and den trees. After you have identified the snags and den trees already on your land, you should look for trees that would make likely candidates in areas (0.6 acre) devoid of snags. Creating a potential snag is easy. Choose a tree of suitable diameter (6 inches) and appropriate species (see Appendix 3 in Guitiérrez et al. 1979) and then girdle it at the base. To girdle the tree, simply take an ax and cut away a 3- to 4-inch band of bark around the circumference of the trunk. You may also want to paint this cut area with diesel fuel, though this extra measure is not critical.

To create a future den tree, cut off a 4- to 6-inch-diameter limb that angles upward from the trunk of an otherwise healthy tree. A short stub will prevent the bark from covering the wound, and rain will trickle down the decaying stub and hasten decay in the trunk. Or chop out a section of bark 6 by 6 inches at the base of a suitable wolf tree. These open wounds should allow fungal disease to enter the tree and begin the decay process. Over the years a natural cavity should form. Elm, ash, sycamore, and basswood are especially prone to form natural cavities.

If you have few or no snags or den trees on your land, you may want to build and place nest boxes for birds and mammals (see Project 5). These structures can serve as substitutes for natural cavities while the

FIGURE 13. Wolf tree

selected trees rot. These trees will not be suitable for dens and nest cavities for several years. You may also want to drill holes 2 inches in diameter into suitable den trees; it is best to make the holes under limbs 3 inches or larger in diameter.

Sources of information on den and cavity tree preservation: 1, 10, 11, 18, 22, 23, 24, 45.

FIGURE 14. Drill holes at the base of a tree limb to initiate a tree cavity.

Good wildlife habitat must have adequate cover. Probably the most critical components of cover are nest sites. These are typically in short supply on the "clean" farms and in the young managed woodlots of today's rural areas.

Nest sites can take many forms, but those most frequently in scarce supply are tree cavities. A tremendous variety of birds and mammals use tree cavities for nest sites. Creation of natural cavities can be enhanced by the practices suggested in Project 4, but these usually take a long time to become suitable places for cavity-nesting wildlife.

You may want to provide nest structures for wildlife that would find food, water, and other cover requirements suitable on your land right now. These artificial homes can take many forms; this project includes nest boxes for various songbirds, squirrel boxes, raccoon dens, artificial burrows for rabbits, and nest boxes for wood ducks (see Table 3).

Nest Boxes for Birds

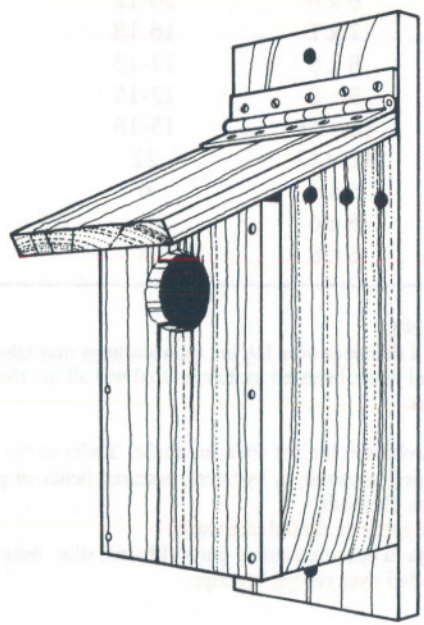
Hole-nesting birds have few needs, and these may often be met with a small expenditure of time and work. To make the nesting facilities safer and more suitable for the occupants, certain principles of construction, design, and location should be observed. A well-built birdhouse should be durable, rainproof, cool, and readily accessible for cleaning. Furthermore, if you adopt high standards of neatness and rustic beauty in construction, birdhouses can not only encourage beneficial species but also add an attractive touch to the landscape.

Materials: Wood is the best building material for birdhouses. Metal should be avoided because it gets too hot when exposed to the sun. Pottery nest boxes have advantages, but they are not easy to make in the average home workshop. Nest boxes constructed of tar paper or similar products have no advantage over wooden ones, and these materials are impractical for building larger houses. An easily workable wood such as pine or yellow poplar is preferable. Sawmill waste (rough slabs with the bark on) furnishes cheap and satisfactory material for rustic nest boxes.

Paint: If a rustic finish is not sought, paint greatly improves the weathering qualities of birdhouses. Dull tones of brown, gray, or green are generally the best choices. Martin houses and others placed in exposed situations should be painted white to reflect heat.

Protection from rain: Roofs should be made with sufficient pitch to shed water readily; or if level, or nearly so, a groove should be cut across the undersurface of the overhanging part to prevent water from draining back into the interior of the house. The overhang should extend 2 to 3 inches to protect the entrance hole from driving rain. The opening of the nest cavity can be bored at an upward slant to aid in keeping out water. A strip of metal or roofing paper often helps to make the ridge of the nest box thoroughly waterproof; flat roofs should be either wholly covered with such material or heavily painted. In areas where freezing weather is the rule in winter, birdhouses last longer if the sides are extended beyond the bottom of the box to drain off water that otherwise might freeze in the crack between the bottom and sides and wedge them apart. To provide for the contingency that some water may get inside the box, a few small holes can be made in the bottom.

FIGURE 15. Birdhouses can be constructed in a variety of shapes and sizes. Some birds have special requirements so be sure you use the proper dimensions (see Table 3).



Protection from heat: If attention is paid to the principle of cool construction, nestlings will suffer less during periods of excessive heat. Wood is a fairly good heat insulator, but the interior of the average nest box is small, and a single opening near the top permits little ventilation. One or two small auger holes through the walls near the top of the box give limited circulation of air without producing drafts.

Accessibility: All birdhouses should be placed so they are readily accessible and built so they are easy to open and clean. A variety of arrangements can be used to allow you to inspect the nest. Birds should not be disturbed when nesting.

Entrances: Since entrance holes for birdhouses are usually near the top, they should be roughened, grooved, or cleated to assist the young in climbing to the opening. Houses longer than high are comfortable and convenient and seem to be liked by some species, particularly birds that do not have an inborn preference for the type used either by woodpeckers or by birds partial to old woodpecker holes. Perches at the entrance seem more of an assistance to enemies than a requirement for the occupants.

Dimensions and elevation: The simplicity of construction of the single-room birdhouse precludes the need for detailed working drawings in most cases. Table 3 gives the proper dimensions for the various species and the height at which the boxes should be placed above the ground.

Table 3. Dimensions and height above ground of nesting boxes for various species of birds regularly using them

Species	*Floor of cavity*	*Depth of cavity*	*Entrance above floor*	*Diameter of entrance*	*Height above ground or water (W)*	*Preferred habitat codes§*
	Inches	Inches	Inches	Inches	Feet	
House wren	4 x 4	6–8	4–6	1–1¼	4-10	2,6
Chickadee	4 x 4	9	7	1⅛	4-15	2
Titmouse	4 x 4	9	7	1¼	5-15	2
Downy woodpecker	4 x 4	9	7	1¼	5-15	2
Nuthatches	4 x 4	9	7	1⅜†	5-15	2
Bluebird	4 x 4	8-12	6-10	1½*	3-6	1
Tree swallow	5 x 5	6-8	4-6	1½*	4-15	1
Hairy woodpecker	6 x 6	12-15	9-12	1⅝	12-20	2
Great crested flycatcher	6 x 6	8-10	6-8	1¾	8-20	1,2
Red-headed woodpecker	6 x 6	12	9	2	10-20	2
Purple martin	6 x 6	6	1	2¼	10-20	1
Saw-whet owl	6 x 6	10-12	8-10	2½	12-20	2
Flicker	7 x 7	16-18	14-16	2½	6-30	1,2
Screech owl	8 x 8	12-15	9-12	3	10-30	2
American kestrel	8 x 8	12-15	9-12	3	10-30	1,4
Barn owl	10 x 18	15-18	0-4	6	12-18	4
Wood duck	12 x 12	22	17	4	10-20, 6W	3,5
Phoebe	6 x 6	6	‡	‡	8-12	6,7
Barn swallow	6 x 6	6	‡	‡	8-12	6,7
Robin	6 x 8	8	‡	‡	6-15	6

SOURCE: Adapted from Boone 1980.

*Precise measurement required; if diameter over 1½ in., then starlings may take over cavity.

†Red-breasted nuthatch (1¼) and white-breasted nuthatch (1⅜) will all use the same box. However, the smaller opening sizes where appropriate may discourage use by house sparrows.

‡One or more sides open.

§Preferred habitat codes. The numbers in the last column of table 3 refer to the habitat types listed here.

1. Open area in the sun (not shaded permanently by trees), pastures, fields, or golf courses.
2. Woodland clearings or the edge of woods.
3. Above water, or if on land, the entrance should face water.
4. On trunks of large trees or high in little-frequented parts of barns, silos, water towers, or church steeples.
5. Moist forest bottomlands, flooded river valleys, swamps.
6. Backyards, near buildings.
7. Near water; under bridges, barns.

Housing for Mammals

Housing for Squirrels

The gray squirrel is one of New York's most popular wildlife species and is a favorite game animal. Gray squirrels also provide nonhunters and nature watchers with hours of enjoyment.

If you are interested in attracting squirrels to your woodlot or backyard, you will want to consider providing artificial dens for them. Studies have shown that the number of available dens is second in importance only to the food supply in determining the squirrel population in a given area. Squirrels prefer natural cavities in trees, but in forests where cavities are not abundant, it may take years to create suitable dens (see Project 4). Constructing and erecting artificial dens can alleviate this housing shortage immediately and attract squirrels to areas where food is available.

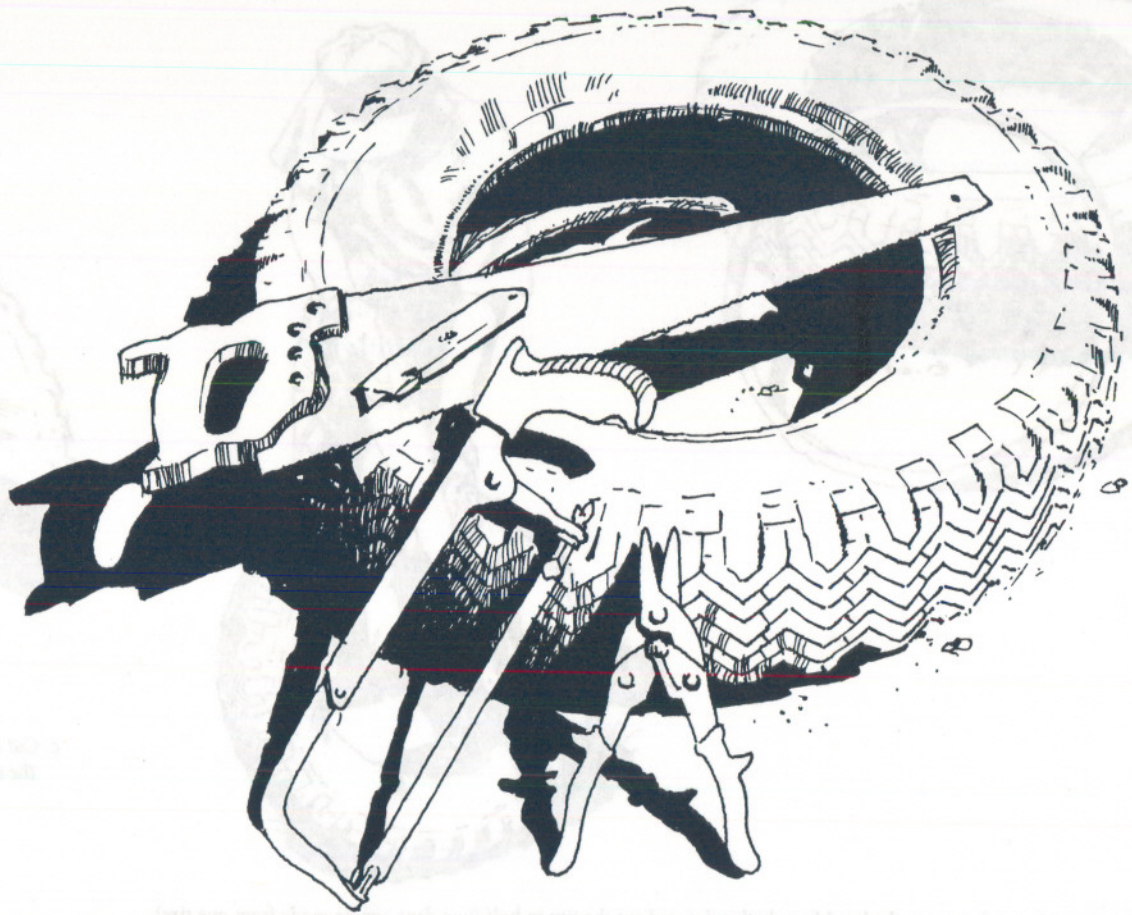
Automobile Tire Den

A simple, inexpensive, and extremely durable squirrel den can be made from discarded automobile tires. Follow the directions given in Figure 16 to build your own tire squirrel den.

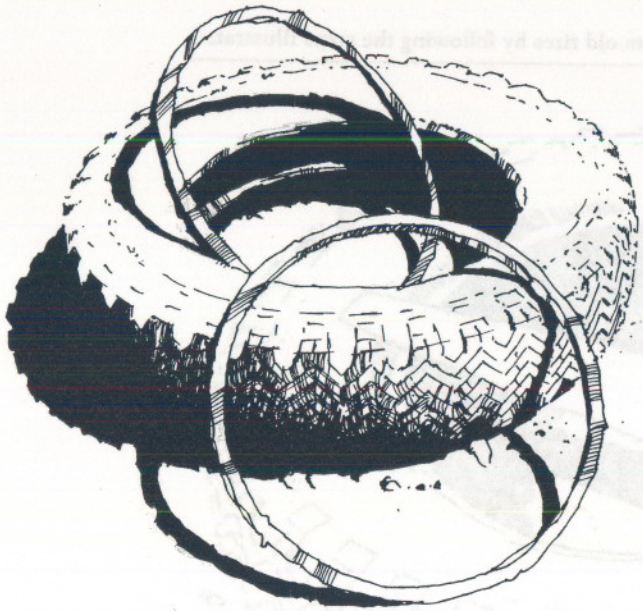
The tire den should be placed approximately 15 to 30 feet high in a tree, with the entrance hole facing the trunk of the tree and slightly toward the ground so that rain cannot enter the den.

In areas where food trees such as hickory, white oak, beech, and walnut are abundant, place several dens per acre. If food is less abundant, place fewer dens.

FIGURE 16. Dens for squirrels can be constructed from old tires by following the steps illustrated.



a. Obtain a regular (non–steel-belted) tire, hacksaw, carpenter's saw, quarter-inch drill, tin snips, utility knife, heavy wire, and quarter-inch bolts.

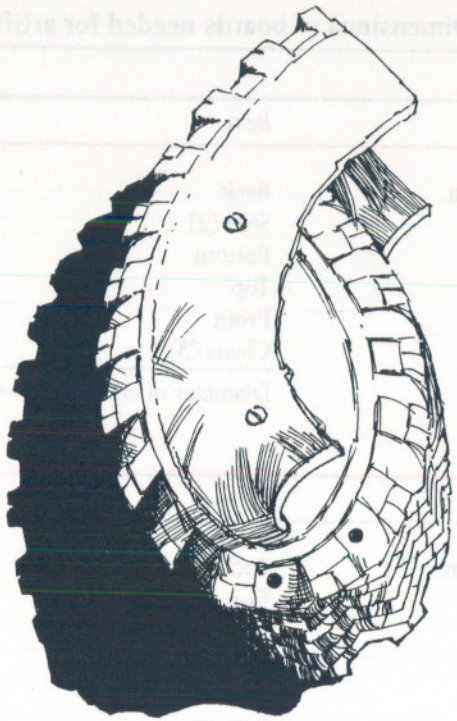


b. With a sharp, strong cutting tool, remove the bead from both sides and cut the tire in half (two dens can be made from one tire).

c. Cut a 3-inch triangle from each corner of one end of the sidewall.

d. In one end of the tire half, cut a semicircle 3 inches in diameter from the tread surface.

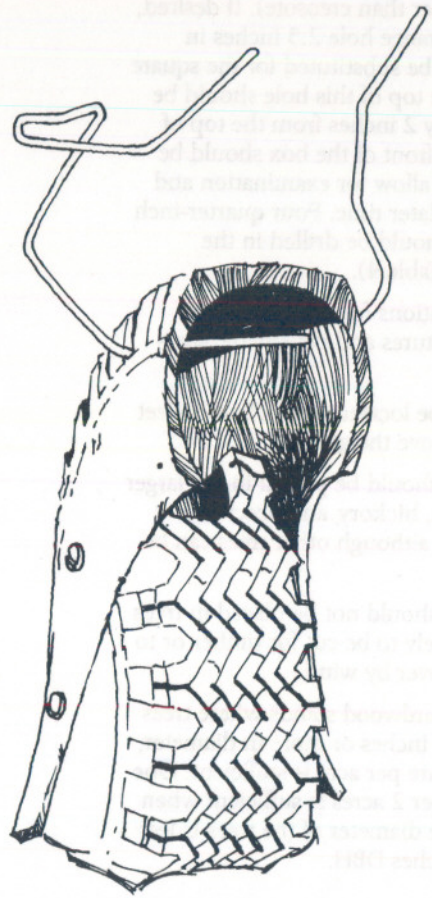
e. Cut 3-inch flaps into each sidewall of the tire about one-third of the distance from the semicircle to the other end of the tire.



f. Fold the short end of tire into the long end.

g. Drill two holes through both sides of the tire and bolt it in a folded position.

h. Drill four drain holes at bottom.



i. Drill holes near the top of tire and insert a heavy wire hanger.

Squirrel Boxes

Boxes should be constructed of 1-inch cypress, 0.5- to 1-inch exterior or marine plywood, or any substantial 1-inch lumber that has been treated with a wood preservative (other than creosote). If desired, a circular entrance hole 2.5 inches in diameter can be substituted for the square entrance. The top of this hole should be approximately 2 inches from the top of the box. The front of the box should be removable to allow for examination and cleaning at a later time. Four quarter-inch drain holes should be drilled in the bottom (see Table 4).

Recommendations for the location of squirrel structures and density of placement follow:

- Boxes can be located from 15 to 30 feet or more above the ground.
- Structures should be placed in the larger trees. Oaks, hickory, and beech are preferable, although other trees can be used.
- Structures should not be placed in trees that are likely to be cut for timber or to be blown over by wind.
- In mixed hardwood stands where trees average 10 inches or more in diameter, one structure per acre is sufficient. One structure per 2 acres is sufficient when the average diameter of the trees is less than 10 inches DBH.

Table 4. Dimensions of boards needed for artificial squirrel and raccoon dens

		Materials needed		
	Item	*Thickness*	*Width*	*Length*
			inches	
Squirrel den	Back	3/4	8	28
	Side (2)	3/4	7 1/4	20 1/4
	Bottom	3/4	6 1/2	7 1/4
	Top	3/4	8	10
	Front	3/4	8	18
	Cleats (3)	1/2	1/2	3
	Diameter of entrance 3"–4"			

		Materials needed		
	Item	*Thickness*	*Width*	*Length*
			inches	
Raccoon den	Back	3/4	10	30
	Front	3/4	10	23
	Left side	3/4	9 1/4	25
	Right side	3/4	9 1/4	25
	Top	3/4	10	12
	Bottom	3/4	8 1/2	9 1/4
	Diameter of entrance 6"–8"			

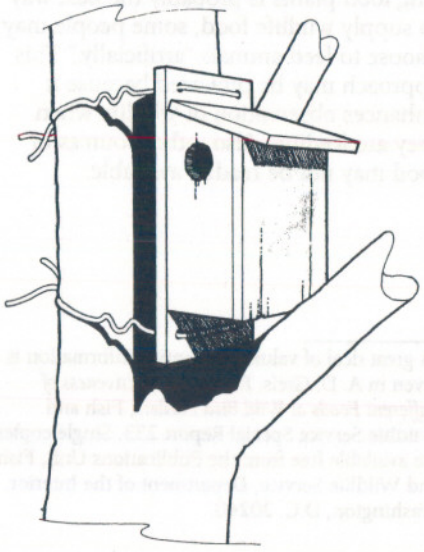
SOURCE: Adapted from J. T. Dans, D. J. Lightfoot, and C. W. Ramsey 1977. *Learning about Texas mammals*. 4-H Member Guide WM5.011. Texas Agricultural Extension Service, College Station.

- Structures should not be placed in stands of mature hardwoods where there is an adequate number of natural dens.
- Structures should not be placed within 100 yards of occupied human dwelling houses or within city limits.
- When boxes are mounted in trees, they should be rested on a sturdy limb. A heavy-gauge, rustproof wire should be passed through small holes drilled in the box and around the trunk of the tree. This wire should be crimped so that it can expand as the tree grows. See Figure 17.
- Boxes should be mounted so that the entrance hole is next to the trunk of the tree. Figure 17 shows the best location for a den entrance hole.

Artificial Raccoon Den

Den sites for raccoons are also sometimes scarce. Artificial dens can be constructed (see Table 4) and located to encourage more raccoons to live in your woodlot. The general provisions for location of structures and density of placement given for squirrel dens can be used for raccoon dens except that there should be only one box per 10 acres and dens should be placed a minimum distance of 200 yards from an occupied dwelling.

FIGURE 17. Wooden nest boxes can be provided for squirrels and raccoons.



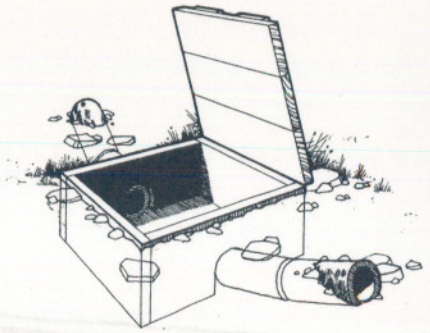
Artificial Rabbit Burrow

Ground-dwelling animals such as rabbits are attracted to underground boxes. These animals often depend on woodchuck burrows for protective cover in the winter. In newly created open areas there may not be any burrows. In this case you can provide cover by burying artificial burrows. Decay-resistant, pressure-treated lumber will greatly outlast untreated lumber. If you would like a fairly permanent installation, cinder blocks can be used. As is true of all artificial wildlife homes, they need not be attractive to the human eye.

The dimensions of the artificial burrow are not critical. Artificial burrows 18 inches by 18 inches by 12 inches high have shown good results. For durability, lumber at least 0.75 inch thick should be used.

The burrows are buried at ground level with a removable top and two tile entrances at opposite ends. The top of the box (a bottom is not essential because the ground serves well) should keep out as much light as possible. These tops can be covered with brush to ensure that the interior of the box is dark, like a natural burrow.

FIGURE 18. Artificial burrows can be made for rabbits; these are especially beneficial in areas where clearings are newly created.

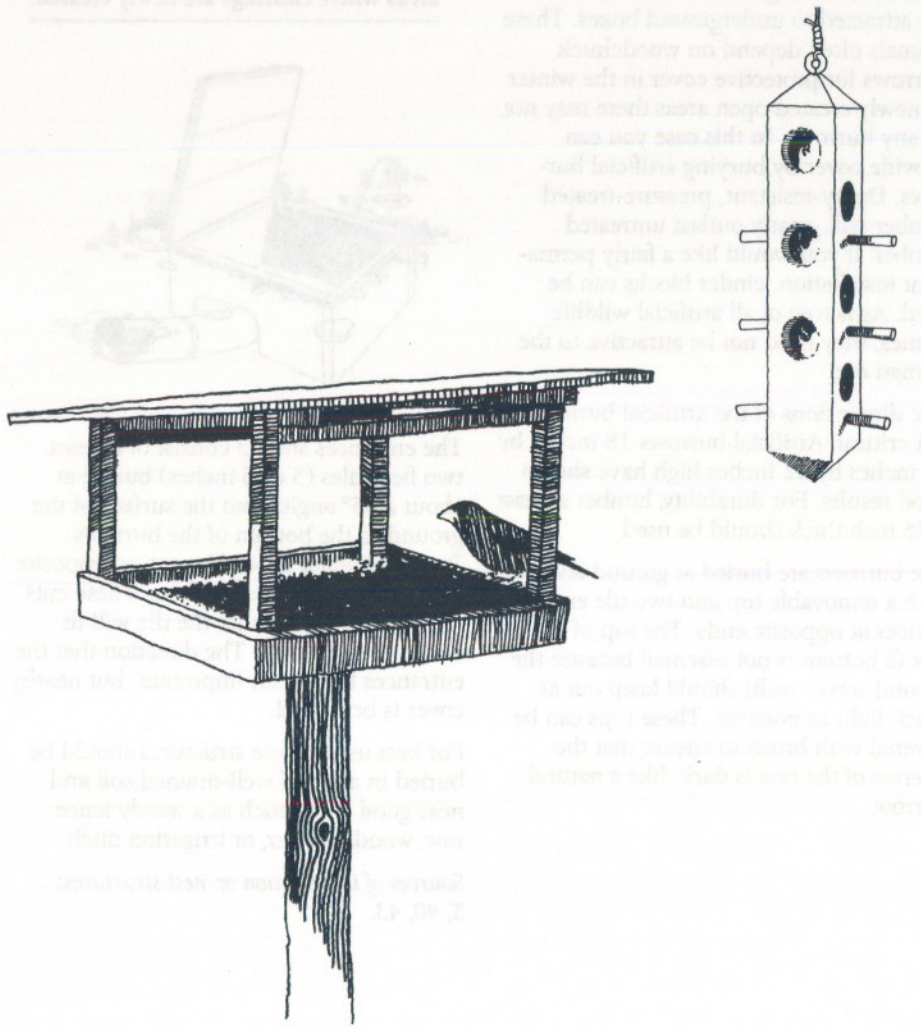


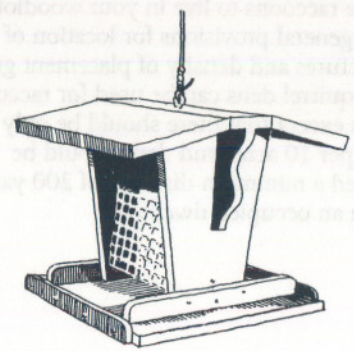
The entrances should consist of at least two field tiles (5 or 6 inches) buried at about a 45° angle from the surface of the ground to the bottom of the burrows. Two semicircles should be cut on opposite ends at the bottom of the box. These cuts should be made so that the tile will fit snugly into the box. The direction that the entrances face is not important, but nearby cover is beneficial.

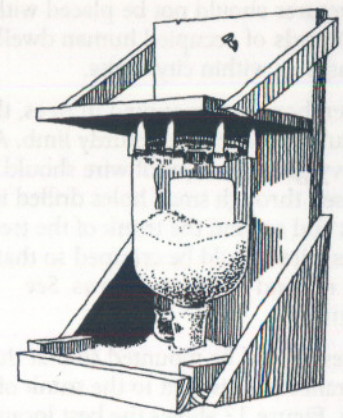
For best usage these structures should be buried in areas of well-drained soil and near good cover such as a weedy fence row, woods border, or irrigation ditch.

Sources of information on nest structures: 5, 40, 43.

FIGURE 19. A variety of feeding stations can be made for songbirds.







Food is one of the basic requirements for all wildlife on your land.[5] Although planting or maintaining naturally occurring food plants is probably the best way to supply wildlife food, some people may choose to feed animals "artificially." This approach may be preferred because it enhances observation of wildlife when they are feeding. Also, other sources of food may not be readily available.

Artificial feeding is typically a winter activity because winter is the time when food for wildlife is scarce in the Northeast. Birds are the most frequent objects of winter feeding, but some people choose to feed other animals, especially squirrels and deer. The practice is not recommended for deer.

[5]A great deal of valuable scientific information is given in A. D. Greis, *Relative Attractiveness of Different Foods at Wild Bird Feeders,* Fish and Wildlife Service Special Report 233. Single copies are available free from the Publications Unit, Fish and Wildlife Service, Department of the Interior, Washington, D.C. 20240.

When you decide to provide food for wildlife over winter, you must realize that you have assumed a major responsibility for the duration of the winter. You are creating an artificial situation because you may be concentrating a relatively large number of animals into an area that cannot support them naturally. Many birds that would otherwise have migrated south to warmer climates will be attracted to your feeding station and remain nearby despite the lack of natural food. Should you not provide enough food or stop feeding before natural food is abundant again in spring, many of the birds will die.

Concentrating deer in this same way could become a serious economic strain because of the volume of food these animals require. Deer are a particular problem because they cannot thrive on just any feed—they need high-quality hay and grain. Five months' worth of feed at about 4.5 pounds per deer per day, or 660 pounds per deer for the winter, can quickly become a time- and money-consuming responsibility.

You must remember to locate feeding stations in places with protective cover nearby to shelter the feeding animals from wind and predators—especially house cats.

Various types of feeding stations can be constructed for birds and squirrels. They can be simple or elaborate. The illustrations show many design suggestions.

Sources of information on feeding stations: 22, 35, 44.

FIGURE 20. Pheasant feeders can be conveniently constructed from a 2" x 6" board and some spikes.

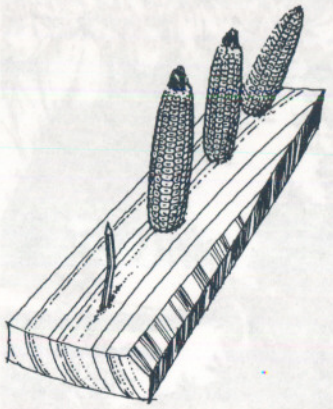


FIGURE 21. A simple turkey feeder is easy and inexpensive to make.

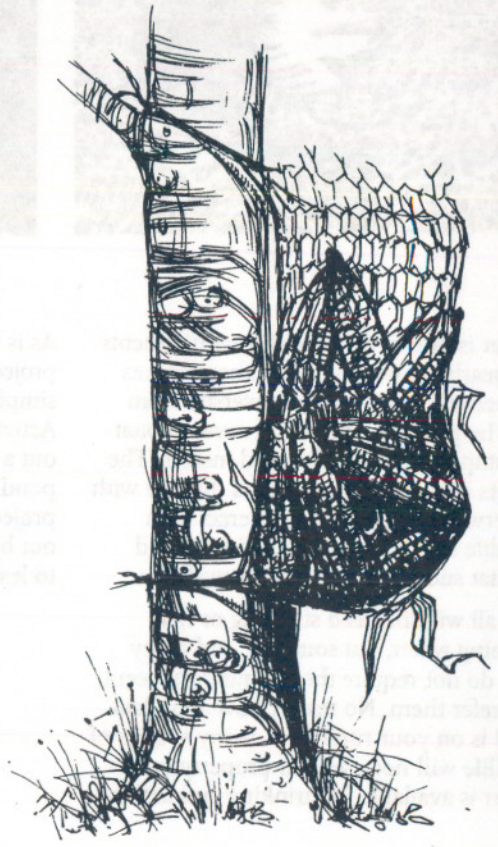


FIGURE 22. A small spring seep can be improved for wildlife use.

FIGURE 23. Natural seeps can be improved with simple hand tools.

Water is one of the basic life requirements for nearly all wildlife. Water contributes immensely to the overall diversity of an area by providing food and cover habitat for amphibians, reptiles, and insects. The plants and animals associated directly with waterways and wetlands interact with wildlife species associated with upland habitat such as raccoons and swallows.

Not all wildlife need standing or free-running water, but some do, and many that do not require these conditions seem to prefer them. No matter how abundant food is on your rural land, many species of wildlife will not use your property unless water is available for drinking and bathing.

As is true of any wildlife enhancement project, you can make the activity as simple or sophisticated as you desire. Activities can range from simply digging out a spring seep to constructing a farm pond. Since we are trying to provide projects in this bulletin that can be carried out by using ordinary tools, we will stick to less ambitious activities.

Digging Out a Spring Seep or Stream Pool

If a spring seep or small brook traverses your land, you can easily create a pool. Before altering streams or wetland, you must contact your regional New York State Department of Environmental Conservation office to check for regulations. You will find the biologists to be of great help in designing or possibly financing the project.

Locate the seep (or section of small stream) where you would like to build the pool. Although at first thought you might opt to locate the pool in an open area, this is not the best placement. Rather, choose a spot with protective vegetation nearby, preferably growing right up to the water's edge. This provides both escape cover and concealment. The shade afforded by these plants also helps keep the water cool. Remember, the pool is most useful to wildlife if it is near their sources of food.

All the equipment you need are rubber boots, a pointed shovel, and possibly a pick. Being careful not to destroy unnecessarily any nearby vegetation, dig out a pool about 1 yard in diameter and 1.5 feet deep.

Line the walls of this little pool with rock and stone, brick, or cement block to prevent the sides from eroding or caving in. Unless there is a natural supply of stone nearby, you may want to bring the lining materials to the excavation site before you begin digging.

You may choose to make a seep pool larger than 1 yard in diameter, but if so you will probably need a plastic liner because it would be difficult to lay an adequate rock or masonry wall around a larger pool. The plastic (or rubber) sheet technique is not too difficult to use. If you choose plastic, make sure it is chemically inert and will not react with water or other material to generate toxic by-products harmful to aquatic organisms that may attempt to live in the pool.

Dig out the pool to the desired size and shape. After the initial excavation, leave the pool for a few hours to allow the sediment in the water to settle. Once the water has cleared enough for you to see the sides and bottom, check the pool area and remove any sharp or pointed roots that could puncture the plastic liner.

Line the pool with one or two layers of heavy plastic. At the edge of the pool, secure the sheet by shoveling soil over its ends all the way around the pool. Then put stones or rocks on top of the soil to anchor the liner.

Using a synthetic liner will disrupt the vegetation close to the pool because you need to bring the edges of the liner over the lip of the pool and anchor it there with soil and stone. By planting willow twigs along the edge, you can be sure that within a year or two some vegetative cover will be established.

FIGURE 24. Lining the walls of the pool will make it last longer.

Stream Habitat Improvement

Streams and the associated streamside, or riparian, habitat are critical environments for wildlife. Stream channels are the primary habitat for fish, amphibians, muskrat, beaver, and otter. Deer and other terrestrial species also depend on streams as a source of water and food and as corridors between isolated patches of forest and field. Throughout much of the landscape, streams have been badly degraded. Native plants have been cleared for farming or trampled by livestock grazing along the streams. These activities cause stream banks to erode and water quality to deteriorate because of increased siltation during rain or the increased nutrient loadings from fertilizers and livestock manure. Finally, the loss of shading by overhanging vegetation makes the water warmer.

With only minimal effort the stream and stream sides can be enhanced to increase their value for both aquatic and terrestrial wildlife. A vegetated buffer needs to be established along the stream corridor. Buffers that extend 60 to 90 feet away from the stream edge will help filter out many contaminants in surface runoff and groundwater that otherwise would degrade the stream. If livestock are pastured in the adjacent land, fencing will be needed to keep them out of the buffer area and stream. At stream crossings, cattle guards or fencing in the stream can be used to prevent the cattle from wandering into the protected stream corridor.

The next step is to stabilize the stream bank. If it has been badly eroded, the bank will need to be reshaped so that it is stable enough that plantings can become established and trees will not topple over. Shovels, pickaxes, and rakes can be used to grade the bank slope, and care should be taken to reduce soil loss into the stream. Banks should generally be shaped to a slope of less than 50 percent. Summer is the best time of year for shaping when water is low. Reestablishment of the vegetation along the bank and buffer area is crucial for long-term stabilization and is also the key to wildlife enhancement. Selection of the appropriate grass, shrub, and tree species is an important part of the planning process. A good method to determine planting selections is to inventory a similar, vegetated stretch of river nearby. The National Resources Conservation Service or New York State Department of Environmental Conservation staff may sell grass seed mixes or make recommendations. Small trees and shrubs that grow well on stream banks are pussy willow, dogwoods, and alders. Larger trees include willows, poplars, and cottonwoods. Other native shrubs that will do well and provide food for wildlife

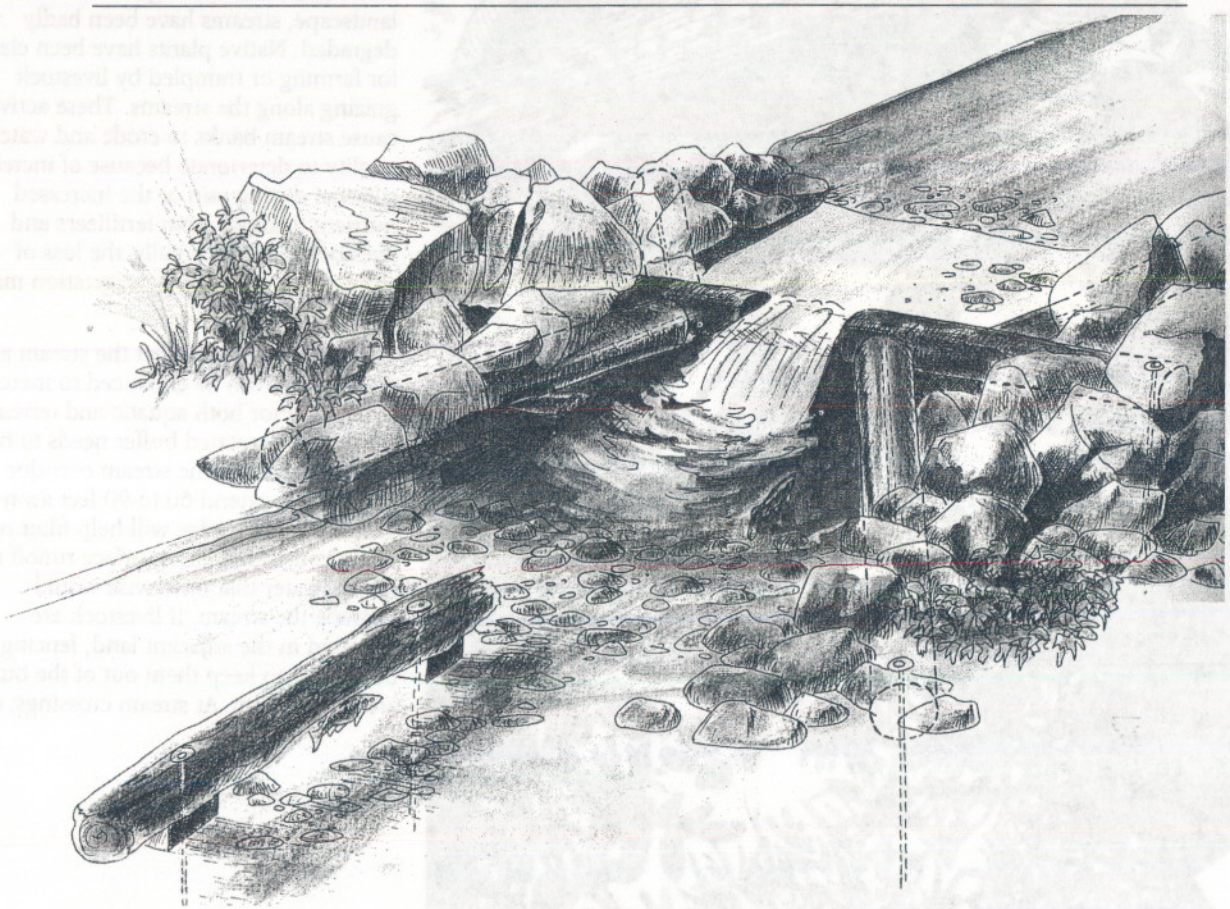
include chokecherry, elderberry, sumac, yew, and juniper.

Grasses should be seeded into bare soil to prevent rain erosion, and shrub and tree seedlings may be interspersed throughout the grass. Use a planting dibble (a stout spade) instead of a shovel will make planting of the seedlings easier, and fertilizer tablets and mulching may improve the survival of seed and seedling. Planting in springtime is important to ensure that root growth is sufficient to survive winter floods and scour. As an alternative to seedlings, willow cuttings are particularly useful for persistently wet areas. They grow rapidly and can reach heights of 12 feet or more in less than three years. Cuttings are generally ¾ inch to 1½ inches in diameter and 16 inches long with a slanted cut. Three-quarters of the cutting's length should be inserted into the soil to maximize surface area for root growth. Willow also sprout profusely when laid horizontally and covered shallowly. Survival is best when cuttings are planted while dormant in spring or fall.

Habitat in the stream can be modified to improve conditions for trout and other fish. Ideally, streams have natural meanders every six to ten channel widths. Shallow riffle areas alternate with deeper scour pools in the meander bends, and these pool areas are important for fish foraging and as refuges. In degraded streams, this natural texture of the stream is lost. A log placed across the stream channel will form a waterfall. A rule of thumb is that the depth of the pool formed should be approximately 1.2 times the height from the surface of the pool to the top of the log. Pool formation can also be encouraged by fixing brush bundles along the upstream, inside corner of the meander bend shoreline to trap sediment.

Sources of information on water projects for wildlife: 7, 27, 28, 39, 47.

FIGURE 25. A "K-dam" creates a plunge pool that provides deepwater habitat in otherwise shallow streams.



SOURCE: Hunt 1993. Used with permission of the University of Wisconsin Press.

Plants are valuable in many ways to the wildlife using your land. They provide food, shelter, and nest sites. Strategic planting of cover-producing conifers, food-bearing shrubs, and plots of grain, clover, and grass can turn your property into a paradise for a variety of birds and mammals.

Planting need not be extensive, but the year-round habitat requirements of wildlife must be considered. For example, plots of cover and grass may be fine for summer and early fall food but do not provide much food or cover during the winter months. The key is to provide a wide diversity of habitat conditions throughout all seasons.

Trees, Shrubs, and Vines

Working with plants to improve your property for wildlife can be very rewarding if you approach the activity with common sense, some basic knowledge about the plants, and a reasonable plan of action. There are many sources of good information on this broad subject. Several examples are cited at the end of this project.

Landowners should be mindful to space their trees or shrubs properly and provide care and maintenance of the planting. There is wisdom in the old advice to "plan you work and work your plan."

A temptation to be avoided is the tendency to concentrate on unusual, exotic, nonnative, or novelty plant species. Some exotic plants are excellent and are recommended for certain applications. But we advise you to use and improve on what you already have on your property first. Then it might be appropriate to try a new species or to add a species not locally abundant but native to the area. Native species have passed the test of time for ecological

Table 5. Selected plants for wildlife habitat enhancement

Plant size categories	*Common name(s)*	*Scientific name*	*Soil moisture range (wet to dry)*	*Light tolerance (sun to shade)*	*Flowering dates*	*Dates fruit available*	*Ornamental value*
Tall trees	Eastern white pine	*Pinus strobus*	moist/dry	sun	-	Aug-Sept	excellent
	Eastern red cedar	*Juniperus virginiana*	moist/dry	sun	-	Sept-May	excellent
	Red maple	*Acer rubrum*	moist/well drained	sun/shade	-	May-July	excellent
	Black cherry	*Prunus serotina*	moist/dry	sun	-	Aug-Oct	good
	White oak	*Quercus alba*	moist/dry	sun/lt. shade	-	Sept-Nov	excellent
	Red oak	*Quercus rubra*	moist	sun/lt. shade	-	Sept-Oct	excellent
	Spruce	*Picea* spp.	moist/well drained	sun/lt. shade	-	Aug-Sept	good/excellent
	Birch	*Betula* spp.	moist/dry	sun/lt. shade	-	Aug-Oct	good/excellent
	Red pine	*Pinus resinosa*	well drained/dry	sun	-	Aug-Sept	good
	Northern white cedar or arborvitae	*Thuja occidentalis*	wet/dry	sun/shade	-	Sept-Nov	excellent
Medium to small trees	Chokecherry	*Prunus virginiana*	moist/dry	sun/lt. shade	May-June	July-Sept	fair
	Flowering dogwood	*Cornus florida*	well drained/dry	sun	May-June	Aug-Dec	excellent
	Box elder	*Acer negundo*	moist/dry	sun/shade	-	Sept-Oct	poor
	White mulberry	*Morus alba*	moist	sun	May-June	June-July	good
	Red mulberry	*Morus rubra*	moist	sun	May-June	June-July	good
	Mountain ash	*Sorbus* spp.	moist/dry	sun/lt. shade	May-June	Aug-March	excellent
	Crab apple	*Malus* spp.	moist/dry	sun	May	Sept-March	good
	Hawthorne	*Crataegus* spp.	moist/dry	sun	May-June	Sept-March	excellent
	Serviceberry or Juneberry	*Amelanchier* spp.	moist/dry	sun/lt. shade	May-June	June-Aug	good
	Fire or pin cherry	*Prunus pensylvanica*	moist/dry	sun/lt. shade	May-July	July-Oct	fair
	Common or American hackberry	*Celtis occidentalis*	dry	sun	Apr-May	Sept-Nov	good

(continued on page 32)

suitability and have few of the limitations or risks associated with exotic species.

Table 5 lists a variety of trees, shrubs, and vines, including a few exotic species, that have been selected because they have been proven to enhance wildlife habitat. From this list of plants single species or combinations of species could be planted to meet a variety of objectives, depending on the characteristics of the planting site or the species of wildlife of interest. Wildlife users of these plus other selected woody plants found in New York are given in Appendix 1 of Information Bulletin 157, *Managing Small Woodlands for Wildlife*, by Gutiérrez et al. Guidelines and planting suggestions are included in much of the literature cited. Be certain to consider the various ecological conditions that must be met such as light, soil fertility, moisture, and biological characteristics of the species.

Yet another concern when choosing plant species is their susceptibility to deer browsing. Unless protected by plastic tubing or small wire enclosures, many species of plants will be stunted or eliminated in areas of high deer populations.

Plants can be obtained from a variety of sources. They are available from commercial nurseries or the New York State Department of Environmental Conservation Tree Nursery (518-581-1439), or you can transplant wild seedlings or grow your own from seeds.

Table 5. Selected plants for wildlife habitat enhancement *(cont.)*

Plant size categories	*Common name(s)*	*Scientific name*	*Soil moisture range (wet to dry)*	*Light tolerance (sun to shade)*	*Flowering dates*	*Dates fruit available*	*Ornamental value*
Tall shrubs	Autumn olive	*Elaeagnus umbellata*	moist/dry	sun/lt. shade	May-July	Aug-Jan	good
	Gray dogwood	*Cornus racemosa*	well drained/dry	sun	June-July	Aug-Oct	good
	Tartarian honeysuckle	*Lonicera tatarica*	well drained/dry	sun/shade	May-June	June-Aug	fair
	Highbush blueberry	*Vaccinium corymbosum*	wet/dry	sun	May-July	July-Sept	fair
	Silky dogwood	*Cornus amomum*	wet/dry	sun/lt. shade	May-July	Aug-Oct	fair
	Red-osier dogwood	*Cornus stolonifera*	wet/moist	sun	May-June	July-Sept	good
	Amur honeysuckle	*Lonicera maacki*	well drained/dry	sun/shade	May-July	Sept-March	fair
	Holly	*Ilex* spp.	wet/well drained	sun/shade	May-June	Aug-June	good/excellent
	Elderberry	*Sambucus canadensis*	wet/well drained	sun/lt. shade	June-July	Aug-Sept	poor
	Highbush cranberry	*Viburnum trilobum*	wet/well drained	sun/lt. shade	May-June	Sept-May	good
	Russian olive	*Elaeagnus angustifolia*	wet/dry	sun	June-July	Sept-Feb	fair
	Northern arrowwood	*Viburnum recognitum*	moist/dry	sun/lt. shade	May-July	July-Sept	good
	Staghorn sumac	*Rhus typhina*	well drained/dry	sun	June-July	Aug-Sept	good
	Buttonbush	*Cephalanthus occidentalis*	wet/moist	sun/shade	July-Aug	Sept-Nov	fair
Medium to low shrubs	Blackberry	*Rubus allegheniensis*	moist/dry	sun/lt. shade	May-July	July-Sept	poor
	Raspberry	*Rubus spp.*	moist/dry	sun/lt. shade	May-June	July-Aug	poor
	Blueberry	*Vaccinium spp.*	wet/dry	sun/lt. shade	May-July	July-Sept	fair
	Huckleberry	*Gaylussacia spp.*	wet/dry	sun/lt. shade	May-June	June-Sept	fair
	Arnot bristly locust	*Robinia fertilis*	well drained/dry	sun	May-June	Aug-Sept	good
Vines	Virginia creeper	*Parthenocissus quinquefolia*	moist/dry	sun/shade	June-Aug	Sept-Jan	excellent
	Bittersweet	*Celastrus scandens*	welldrained/dry	sun/lt. shade	May-June	Sept-Dec	excellent
	Fox grape/Summer grape	*Vitis labrusea/ V. gestivalis*	moist/dry	sun/lt. shade	May-July	Sept-Oct	poor

SOURCE: Adapted from C. P. Dawson and D. J. Decker, *Plants for Improving Wildlife Habitat around Your Home*, *Conservation Circular*, vol. 16, no. 7 (Ithaca: Department of Natural Resources, New York State College of Agriculture and Life Sciences, Cornell University, 1978).

FIGURE 26. Overmature sumac loses much of its value for wildlife. Sprouting of new growth can be encouraged by mechanical disturbance.

Sumac Rejuvenation

The staghorn sumac, *Rhus typhina,* is a native shrub that is of great value to wildlife. Sumac fruit is consumed by ring-necked pheasant, turkey, ruffed grouse, and at least 30 species of songbirds. The fruit, stems, and bark are important winter food items for deer and cottontail rabbits. This shrub has very attractive fall foliage and colorful, persistent fruit, which add to its value as an ornamental shrub.

Sumac is common in New York and is well suited for establishment in old fields, along roadsides, in clear-cut areas, and in disturbed sites. It can be started from seeds or nursery stock, transplanted from the wild, or even propagated from root cuttings. Another alternative is perhaps the easiest and least expensive if you already have some sumac with which to work. Sumac responds well to mechanical disturbance. When the crown has grown beyond the reach of browsers and the shrub becomes overmature and unthrifty, cutting back these old stems produces vigorous root sprouting provided the stand is not shaded. These young sprouts provide new browse and prolong the usable life of the plants for wildlife. Even more drastic measures such as plowing and mowing may also restore the vigor of the plants for several years.

Nut Tree Management

Mast, the nuts and acorns from a variety of trees, is an important source of food for many species of wildlife. Deer, turkey, squirrel, and raccoon are probably the best-known consumers of mast.

If you have a few mast trees on your property such as butternut, hickory, beech, oak, or walnut, you can improve nut production and the overall health of the tree through several management practices. Obviously, economics and the time you have available will determine the number of trees you might want to manage or how intensive your management will be. As a beginning it might be best to select only one or two trees to work on to gain experience and to evaluate the results of your efforts.

All nut trees benefit from thinning to allow the tree crown to develop more fully. As a general rule, all trees with crowns that overtop or touch the sides of the desired nut tree should be removed. Leave a band of about 5 feet for the crown to expand.

Once the thinning has been completed, the tree can be fertilized to encourage further nut production and overall growth. A complete fertilizer such as a 5-10-5 or 10-10-10 formula is recommended. The maximum rate at which fertilizer should be applied is 2 pounds of 5-10-5 for every 1 inch of diameter at 4.5 feet from the ground. Use one-half this amount of 10-10-10. The fertilizer can be broadcast on the ground under the spread of the crown, or it could be placed in a series of 8- to 10-inch-deep holes in the ground. These holes can be made with a crowbar in the circular area covered by the crown. The best time to fertilize is early spring when growth is beginning. It may also be helpful to prune dead, damaged, or diseased branches. Several references listed at the end of this project give additional information on nut tree culture and management. This activity is similar to Project 3, "Release and Care of Wild Apple Trees."

FIGURE 27. Nut trees can be made more productive by clearing, pruning, and fertilizing (very similar to the release and care of wild apple trees).

Food Plots

Many commonly planted agricultural grass, grain, and green field crop species are excellent wildlife food. Plots of these plants for wildlife can be established to provide additional food if adequate wild foods, winter grasses, or grains are not already available. Planting these crops specifically for wildlife requires a technical level of knowledge, availability of farm equipment, and an outlay of time and money, but the result of this effort can be dramatic. An additional advantage or reason for undertaking this project would be not only to provide food but also to concentrate wildlife in a desired area. Most of these plants must be reestablished annually.

If you are not already an experienced farmer, you should seek advice from your county Cooperative Extension agent, state wildlife biologist, Natural Resources Conservation Service biologist, or an active farmer about local growing conditions and successful cultivation practices.

Table 6 provides information about plants that are especially useful to wildlife. Keep in mind that proper placement, quality of the planting site, and size of the food plot are important. Many small, long, and narrow food plots strategically located near cover and well dispersed over your property are much better than one or two large plots.

Often annual wildlife food plots can be undertaken as a joint project with neighbors, hunting companions, or club members. This project, as well as most of those discussed in this bulletin, provides an excellent opportunity to involve youth. In this way you can help them appreciate and understand the importance of the private landowner's role in good wildlife resource conservation.

Sources of information on planting and plants: 2, 12, 16, 19, 20, 21, 22, 30, 33, 35, 36, 37, 38, 46, 47.

Table 6. Plants for wildlife food plots

				Availability			
Food plots	*Site requirements*	*Sowing Method*	*Amount per acre*	*Fall*	*Winter*	*Range*	*Wildlife usage*
Buckwheat	Cultivated, well-drained topsoil. Treat with lime and fertilizer as required for local crops. Plant in 1/4- to 1/2-acre plots with abundant light	Broadcast after June 15	50 lb	Fair	Poor	Statewide	Deer, waterfowl, mourning dove, pheasant, quail, Hungarian partridge. Wilts with first frost.
Clover white or red, and alfalfa or trefoil	"	Broadcast on cultivated soil. Most successful after a rain.	2–4 lb 8–10 lb 12–20 lb 5 lb (inoculated)	Good	Poor	Statewide	All wildlife; especially good for ruffed grouse, deer, and rabbits
Common millet	"	Broadcast	20 lb	Fair	None	Statewide	Songbirds, waterfowl
Corn	"	Rows 3' apart, with appropriate weed control.	7 lb	Good	Good	Statewide	Pheasant, quail, Hungarian partridge, mourning dove, turkey, deer, raccoon, squirrel, and songbirds
Early amber sorghum	"	Rows 3' apart. Sow sparsely.	6 lb	Good (late)	Fair	Statewide	Quail, pheasant, turkey, and songbirds

(continued on page 36)

Table 6. Plants for wildlife food plots *(continued)*

Food plots	*Site requirements*	*Sowing Method*	*Amount per acre*	*Availability*		*Range*	*Wildlife usage*
				Fall	*Winter*		
Oats	"	Rows 7" apart. Sow in fall.	2½ bu	Good	Poor	Statewide	Pheasant, turkey, mourning dove, songbirds, deer
Rye	"	Broadcast in fall.	6 pk	Good	None	Statewide	Deer, pheasant, quail
Soybeans	"	Rows 2½' apart	50 lb	Fair	Good	Statewide	Pheasant, quail, rabbits, deer, mourning dove
Sunflower	"	Rows 3' apart, or broadcast	5 lb	Good	None	Statewide	Songbirds, pheasant, quail
Wheat	"	Rows 7" apart. Sow in fall.	2 bu	Good	Poor	Statewide	Mourning dove, Hungarian partirdge
Wild rice	Good soils necessary. Wet soils and soft mud flats water depth under 3'	Broadcast in fall or early spring.	2 bu	Good	Poor	Statewide	Water fowl, songbirds, most other wildlife
Corn and buckwheat	Same as individual planting. Cultivate twice	Rows 3' apart. Broadcast buckwheat after second cultivation.	7 lb corn	Good	Good	Statewide	Pheasant, quail, Hungarian partirdge, mourning dove, turkey, deer, raccoon, squirrel, songbirds
Corn	Same as individual planting. Cultivate twice	Rows 3' apart	4 lb corn	Good	Good	Statewide	Pheasant, quail, Hungarian partirdge, mourning dove, turkey, songbirds, deer, rabbit, raccoon, squirrel
Sorghum and sunflower mixture	Same as individual planting	Rows 3' apart, or broadcast	5 lb sorghum 3 lb sunflower	Good	Fair	Statewide	Quail, pheasant, turkey, songbirds

SOURCE: Adapted from H. D. Doig, *Wildlife Food and Cover Plants*, *Conservation Circular*, vol. 3, no. 4 (Ithaca: Department of Natural Resources, New York State College of Agriculture and Life Sciences, Cornell University, 1965).

9. Creating and Maintaining Openings

If your land is covered with trees and forms a large woodland tract (100 acres or more) by itself or together with adjacent property, you may want to consider creating an area of open space. A forest clearing can enhance the overall plant and animal diversity of an area because it normally produces herbs, grasses, brush, and younger stages of forest growth. This variety of plant types and sizes provides more food and nest sites than does a solid stand of mature forest. Woodland birds such as ruffed grouse and wild turkey bring their broods to these areas to feed on the abundant insect life there. Deer and rabbit will feed on the leaves and buds of shrubs and saplings. Many other birds and mammals also benefit.

An opening can be created specifically for wildlife or can be made as part of a forest management plan. Logging trails and landings that are seeded to grasses can provide openings for wildlife habitat. Clearings should be relatively small, 0.5–5.0 acres, depending on the overall area of the continuous forest. These openings should be dispersed over the area and not concentrated. It is better to have several small clearings than a single large one.

Many wildlife species benefit from the diversity of habitat provided where two or more cover types meet. These "edges" are most beneficial if the transition zone is "softened" by creating a zone of brush between a mature forest stand and a crop field.

The brush accumulated from the cutting operation should be made into brush piles as described in Project 1. These piles should be placed in and along the perimeter of the opening. Living brush piles (see Project 2) should be made wherever the positioning of several saplings allows them to be created.

Clumps of conifers should be left standing in and around openings. They provide valuable cover and shelter for wildlife throughout the year.

FIGURE 28. Food plots are best located near protective cover.

Proper location of forest openings is the key to their prolonged existence and minimal maintenance. Unless a few precautions are taken, small openings quickly revert to their previous condition of being covered with trees. If you follow the suggestions listed below, your forest clearings may remain in the herb-grass-brush stage for 20 to 30 years, providing a long-term return in wildlife values for your initial investment of time.

The best places to make openings are where little or no advanced trees or reproduction are present. Cut in areas that are either poorly to somewhat poorly drained or excessively well drained. Try to pick an area where soil is shallow. Areas that are frost pockets make good locations. Stands less than 50 years old are especially good places for a clearing because they tend to produce small amounts of seed and have the least advanced reproduction. All these conditions make for poor regeneration and slow forest growth, which tend to prolong the life of a clearing.

Brush-hogging the clearing every other year will keep it largely free of brush. The best time to cut the area is mid-July after nesting birds have fledged and grasses still have time to grow back before fall. Once grasses dominate, burning the site before spring green-up every second or third year is a relatively easy and inexpensive way to hold back succession. Contact your state natural resources management agency for technical and regulatory advice.

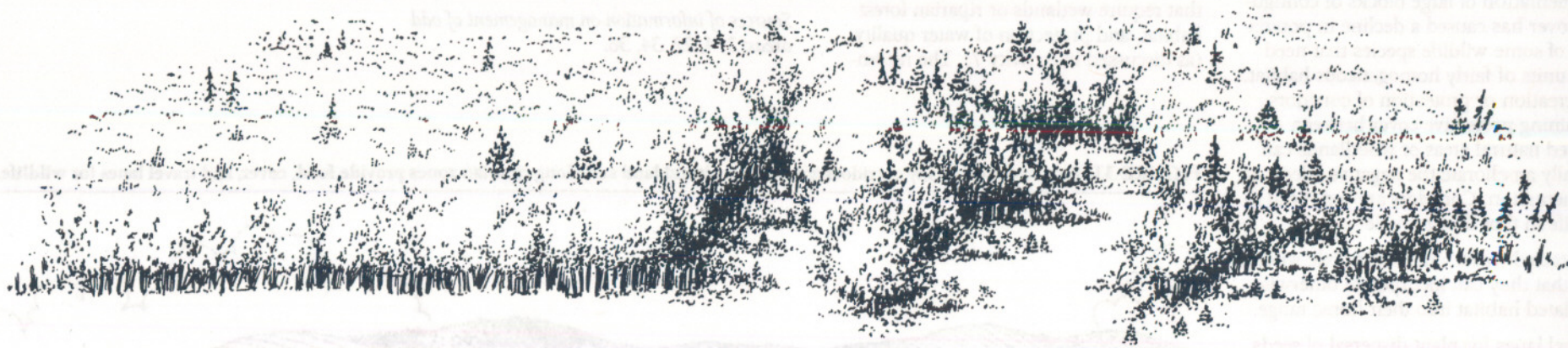
Prospective sites can be located on soil maps, aerial photographs, topographic maps, or forest maps. Follow up with a field examination. Look for patches of swampy ground and seepages within better-drained areas. Another clue is a change in species. For instance, pockets of black ash, red maple, yellow birch, American elm, black spruce, or hemlock growing in the midst of sugar maple generally indicate a wet spot. Do not entirely clear-cut these stands because they are often an important or scarce cover and provide valuable habitat. Conifers provide cover all year.

If possible, create openings that border logging trails, another stand of timber, a swamp, or a marsh. Trails can serve as travel lanes for wildlife; openings that border other forest types contain a greater variety of vegetation.

Sources of information on creating and maintaining openings: 3, 22, 36, 48.

FIGURE 29. **Forest openings should be small, well distributed throughout the woodland, and irregularly shaped.**

FIGURE 30. Increasing edge along forest clearings is of great benefit to wildlife.



If you are fortunate enough to have agricultural land, either crop land or pasture, you probably have considerable amounts of valuable wildlife habitat in the form of odd corners, hedgerows, turn rows, ditch banks, and field borders. These areas of agriculturally inactive land can provide both food and cover for many forms of wildlife. They can also be improved to help prevent soil erosion by wind and water.

Odd areas, if managed properly, are beneficial to both the farmer and wildlife. The trend toward eliminating odd areas through "clean" farming has led to the reduction of wildlife on farmlands, and farmers have not always reaped the benefits promised by clean farming advocates, despite the investments they have made.

The edge formed by natural vegetation or planting in odd areas can be extremely productive for wildlife. These areas provide for a variety of wildlife needs and activities: feeding, loafing, dusting, sunning, nesting, den sites, travel lanes, and escape or protective cover.

Long strips of vegetation such as fence rows, hedgerows, and ditch banks provide a greater linear distance of edge than block parcels representing the same amount of total area. These areas are valuable to the agricultural program from the standpoint of the habitat they provide for insect-eating wildlife, especially birds.

Mammals and birds seem to find most attractive the low, shrub-stage odd areas where seeds, fruit, browse, and overhead cover are most plentiful. Areas with a good mix of seed, shrub, and vine growth provide both food and cover for a variety of wildlife. Following are some suggested management practices:

- Linear odd areas should be at least 12 feet wide, and woody plants should average about 6 feet tall.
- Encourage or plant (see Project 8) natural shrubs and vines.
- Clumps of tall, wide-spreading trees should be removed unless they are den trees, good mast producers, or conifers. Cut selected trees (those 10 inches in diameter) partially through and allow them to fall into the odd area. Do not remove these felled trees for they create a living brush pile. Some trees can be girdled to create snags. No more than one tall tree per 50 yards of linear area or one per quarter-acre should be left alive; if too many trees are left, they will shade out the undergrowth.
- Pile limbs, branches, treetops, and stumps in or along the edges of odd areas.
- Trim tops of trees that grow too high.
- Do not burn or bulldoze in odd areas.
- Do not allow livestock to graze in your odd areas unless the vegetation becomes very thick. Some light grazing may be beneficial.
- After 3 to 5 years, brush cutting may be needed to set back excessive plant growth.
- Odd areas can be created on largely open land by
  - —plowing and disking the area, if needed.
  - —fertilizing the soil, if needed. (This may need to be repeated until vegetation is well established.)
  - —doing some planting (see Project 8).
  - —leaving some trees initially to produce seed and get some cover started on the site. These may need to be cut down later.
- Odd areas can be created on the edge of a woodland by
  - —cutting back the woods edge 10 yards.
  - —using an irregular cutting width to increase edge.
  - —reserving trees of value to wildlife, especially mast-producing wolf trees, den trees, and snags.

Creating odd areas by cutting back woodland edges prevents the need to convert valuable cropland into wildlife production areas.

Corridors

Fragmentation of large blocks of contiguous cover has caused a decline in populations of some wildlife species that need large units of fairly homogeneous habitat. The creation or protection of corridors containing protective cover between isolated natural areas or woodlands can partially ameliorate the negative effects of fragmentation. Corridors are beneficial to wildlife in that they provide

- protected travel lanes for mobile wildlife so that they can incorporate otherwise isolated habitat into their home range.
- travel lanes for plant dispersal of seeds and wildlife species (most commonly dispersing young) allowing repopulation of vacant habitat and reducing the likelihood of genetic inbreeding.
- refuge for wildlife (including insects) forced from adjacent recently cropped agricultural lands or otherwise modified habitat.
- travel lanes for migrating wildlife (songbirds that migrate hundreds of miles and amphibians and insects that migrate a few hundred feet).

Landscape features that serve as corridors include hedgerows, windbreaks, buffer strips along riparian zones, field edges and borders, culverts under roads and developed areas, and agricultural or roadside ditches. Ideally, corridors should be as wide as possible and contain a mixture of cover consisting of grasses, shrubs, and trees. Even a single band of trees can be valuable. Buffer zones along ditches or streams are particularly valuable because they provide travel corridors for a wide variety of wildlife, home ranges for wildlife that require wetlands or riparian forest habitat, and protection of water quality (as discussed in Activity 7). The recommended minimum for a buffer zone is 110 yards (both sides of a stream).

Sources of information on management of odd areas: 3, 4, 22, 34, 36.

FIGURE 31. **Forested and brushy corridors across agricultural land and along riparian zones provide food, cover, and travel lanes for wildlife.**

HELPFUL REFERENCES

The list below contains references from which much of the information in this bulletin was drawn. The reader is encouraged to obtain copies of those items of interest.

1. Anon. N.d. *Den trees.* USDA Soil Conservation Service, Information Sheet NY-2. Washington, D.C. 2 pp.
2. Anon. 1977. *Landowner's guide to wildlife management.* Illinois Department of Conservation, Wildlife Resources Division, Springfield. 13 pp.
3. Anon. 1972. *Field border.* Maryland Department of Natural Resources, Wildlife Management Division, and U.S. Soil Conservation Service, Annapolis. V-D-1 to V-D-3.
4. Bennett, A. F. 1990. Habitat corridors: Their role in wildlife management and conservation. Department of Conservation and Environment, Melbourne, A. R. Institute for Environmental Research, 123 Brown St., Heidelberg, Victoria 3084, Australia. 37 pp.
5. Boone, D. D. 1980. *Homes for birds.* Conservation Bulletin 14. U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C. 24 pp.
6. Briggs, J. N., and D. E. LaHart. 1968. *Apple trees for wildlife. Conservation Circular,* vol. 6, no. 2. Department of Natural Resources, New York State College of Agriculture and Life Sciences, Cornell University, Ithaca. 1 p.
7. Brittingham, M. 1991. *Stream bank fencing.* Extension circular 397. Penn State Distribution Center, 112 Agricultural Administration Building, University Park, Pa. 16802. 12 pp.
8. Bulger, J. D. 1954. *Let's build brush shelters for wildlife.* National Wildlife Foundation, Washington, D.C. 4 pp.
9. Burger, G. V. 1973. *Practical wildlife management.* Winchester Press, New York. p. 102.
10. Carey, A. B., and J. D. Gill. 1980. *Firewood and wildlife.* Forest Service Research Note 299. USDA Northeastern Forest Experiment Station, Upper Darby, Pa. 5 pp.
11. Conner, R. N. 1978. Snag management for cavity nesting birds. Paper presented at workshop, USDA Forest Service, Wildlife Habitat and Silviculture Laboratory, Nacogdoches, Texas. Mimeographed. 9 pp.
12. Decker, D. J., J. Kelley, T. Seamans, and R. Roth. 1990. *Wildlife and timber from private lands: A landowner's guide to planning.* New York State College of Agriculture and Life Sciences, Cornell University, Ithaca. 55 pp.
13. Decker, D. J. 1988. *Wildlife notebook: Sketches of selected wildlife in New York State.* Information Bulletin 210. New York State College of Agriculture and Life Sciences, Cornell University, Ithaca. 67 pp.
14. DeGraaf, R. M., M. Yamasaki, W. B. Leak, and J. W. Lanier. 1989. *New England wildlife: Management of forested habitats.* GTR-NE 144. USDA Forest Service, Northeastern Experiment Station, Radnor, Pa. 271 pp.
15. DeGraaf, R. M., and D. D. Rudis. 1986. *New England wildlife: Habitat, natural history, and distribution.* General Technical Report NE-108. USDA Forest Service, Northeastern Forest Experimental Station, Broomall, Pa. 491 pp.
16. DeGraaf, R. M., and G. M. Witman. 1979. *Trees, shrubs and vines for attracting birds: A manual for the Northeast.* University of Massachusetts Press, Amherst. 194 pp.
17. Durell, J. 1978. *Wildlife management practices.* Kentucky Department of Fish and Wildlife Resources, Frankfort. 12 pp.
18. Evans, K. E. N.d. *How to attract cavity-nesting birds to your wood lot.* USDA Forest Service, North Central Forest Experiment Station, St. Paul, Minn.
19. Farrar, J., ed. N.d. *Planting for wildlife.* Nebraska Game and Parks Commission, Lincoln. 14 pp.
20. Gill, J. D., and W. M. Healy. 1974. *Shrubs and vines for northeastern wildlife.* Technical Report NE-9. USDA Forest Service, Northeastern Forest Experiment Station, Upper Darby, Pa. 180 pp.
21. Gullion, G. W. N.d. *Improving ruffed grouse habitat with proper planting.* Ruffed Grouse Society of North America, Kingwood, Va. 10 pp.
22. Gutièrrez, R. J., D. J. Decker, R. A. Howard, Jr., and J. P. Lassoie. 1979. *Managing small woodlands for wildlife.* Information Bulletin 157. New York State College of Agriculture and Life Sciences, Cornell University, Ithaca. 32 pp.
23. Hardin, K. I., and K. E. Evans. 1977. *Cavity-nesting bird habitat in the oak-hickory forests: A review.* General Technical Report NC-30. USDA Forest Service, North Central Forest Experiment Station, St. Paul, Minn. 23 pp.
24. Hassinger, J., and J. Payne. 1986. *Pennsylvania woodlands: Dead wood for wildlife.* Number 7. Pennsylvania State University, College of Agriculture, Cooperative Extension Service. 6 pp.
25. Hassinger, J., L. Hoffman, M. Puglisi, T. D. Rader, and R. G. Wingard. 1979. *Woodlands and wildlife.* Pennsylvania State University, College of Agriculture, Cooperative Extension Service. 68 pp.
26. Hobson, S. S., J. S. Borclay, and S. H. Broderick. 1993. *Enhancing wildlife habitats: A practical guide for forest landowners.* NRAES 64. Northeast Regional Agricultural Engineering Service, Cornell University, Ithaca. 172 pp.
27. Hunt, R. L. 1993. *Trout stream therapy.* University of Wisconsin Press, Madison. 74 pp.
28. Hunter, C., T. Palmer, and E. Ditzler-Meloy. 1991. *Better trout habitat: A guide to stream restoration and management.* Island Press, Washington, D.C. 320 pp.
29. Hunter, M. L., Jr. 1990. *Wildlife, forests, and forestry: Principles of managing forests for biological diversity.* Prentice-Hall, Englewood Cliffs, N.J. 370 pp.
30. Jaynes, R. A., ed. 1979. *Nut tree culture in North America.* Northern Nut Growers Association, Broken Arrow Rd., Hamden, Conn. 421 pp.

31. Kelsey, P. M. 1977. *Improving cottontail habitat. Conservation Comments.* New York State Division of Fish and Wildlife, New York State Department of Environmental Conservation, Albany. 2 pp.

32. Kotar, J. 1997. *Approaches to ecologically based forest management on private lands.* NR-604. Minnesota Extension Service, University of Minnesota, Minneapolis. 18 pp.

33. MacDaniels, L. H. 1981 rev. ed. *Nut growing in the Northeast.* Information Bulletin 71. New York State College of Agriculture and Life Sciences, Cornell University, Ithaca. 20 pp.

34. Mackintosh, G., ed. 1989. *Preserving communities and corridors.* Defenders of Wildlife, 1244 19th St. N.W., Washington, D.C. 96 pp.

35. Martin, A. C., H. S. Zim, and A. L. Nelson. 1951. *American wildlife and plants: A guide to wildlife food habits.* New York, Dover. 500 pp.

36. McConnell, C. 1971. *Field border management for wildlife.* Tennessee Game and Fish Commission, Game Management Division, Nashville. 2 pp.

37. Morrow, R. R., L. S. Hamilton, and F. E. Winch, Jr. 1981. *Planting forest trees in rural areas.* Information Bulletin 174. New York State College of Agriculture and Life Sciences, Cornell University, Ithaca. 16 pp.

38. National Audobon Society. 1974. *Wildlife habitat improvement.* National Audubon Society, Nature Center Planning Division, 950 Third Ave., New York, N.Y. 96 pp. (p. 28).

39. National Wildlife Federation. 1976. *A pool for the backyard.* National Wildlife Federation, 1412 Sixteenth St. N.W., Washington, D.C. 10 pp.

40. North Carolina Wildlife Resources Commission. 1978. *Artificial housing for squirrels.* 4 pp.

41. Olson, D., and C. Langer. N.d. *Care of wild apple trees.* NA-FB/M-5, USDA Forest Service, Radnor, Pa.

42. Rader, T. D. 1977. *Wildlife management III.* Pennsylvania Forest Resources 47. Cooperative Extension Service, Pennsylvania State University, University Park. 4 pp.

43. Russell, J. N.d. *Artificial homes for wildlife.* Management Series 2. Indiana Department of Natural Resources, Division of Fish and Wildlife, Indianapolis. 10 pp.

44. Sage, R. W., Jr., and K. A. Gustafson. 1991. *Feeding Adirondack deer in winter: Let's understand what we are doing.* Office of News and Publications, College of Environmental Science and Forestry, State University of New York, Syracuse, N.Y. 7 pp.

45. Scott, V. E., K. E. Evans, D. R. Patton, and C. P. Stone. 1977. *Cavity-nesting birds of North American forests.* Agriculture Handbook 511. USDA Forest Service, Washington, D.C. 112 pp.

46. Sharp, W. C. 1977. *Conservation plants for the Northeast.* Program Aid 1154. USDA Soil Conservation Service, Washington, D.C. 40 pp.

47. Thunhorst, G. A. 1993. *Wetland planting guide for the Northeastern United States: Plants for wetland creation, restoration and enhancement.* Environmental Concern, P.O. Box P, 210 West Chew Ave., St. Michaels, Md., 21663. 179 pp.

48. Tubbs, C. H., and L. J. Verne. 1972. *How to create wildlife openings in northern hardwoods.* State and Private Forestry, USDA Forest Service, Washington, D.C. 5 pp.

Many other useful wildlife-related references are included in Gutièrrez et al. (1979).

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