Tarheel Wildlife

A GUIDE FOR MANAGING WILDLIFE ON PRIVATE LANDS IN NORTH CAROLINA

North Carolina Wildlife Resources Commission

Preface

We are blessed in North Carolina with a rich assemblage of wild animals and wildlife habitats from the heights of Mount Mitchell to the sandy beaches of Cape Hatteras. Approximately 90 percent of our 31 million acres of land is privately owned. Private land ownership and the ability to determine the form and function of the land is a long-held and important American right. Along with those rights come certain responsibilities and many opportunities.

Aldo Leopold* wrote that "[t]here are people who can live without wild things and some who cannot." I cannot. My connection to wild animals and their habitats started longer ago than I can remember. On my family's Guilford County farm, I quickly learned about managing the land for multiple personal, economic, and aesthetic benefits. Leopold also wrote that "[t]here are two spiritual dangers in not owning a farm. One is the danger of supposing that breakfast comes from the grocery, and the other that heat comes from the furnace." In farming and land management, we avoid these spiritual dangers and learn the lessons that are forged by planting, growing, harvesting, and consuming our own food; providing for our families; long hours of working the land; glimpsing a mink working a slough; hearing that long-awaited gobbler on a crisp April morning after several years of habitat management; watching gold finches feeding in a field of "weeds;" or welcoming the dawn amid the swirl and buzz of descending waterfowl.

The benefits of land management come in different forms to different people. We manage land for certain habitats and associated wildlife to satisfy our needs. In the 21st century, most land management decisions are economic; however, that need not always be the case. In addition to addressing the economic realities of keeping lands in private ownership and production; aesthetic values; personal pride; watching particular species of wildlife that we find enjoyable; opportunities to hunt, trap, or fish; conserving rare species of wildlife or plants; and seeing the wonder in childrens' eyes as they watch a deer fawn are all reasons that we manage the land. But there are additional reasons, beyond those that are personally important, for us to be thoughtful and deliberate in our land stewardship decisions.

Although most lands in our state are privately owned, wildlife occurring on these lands is publicly owned; they are public-trust resources. Whether state-trust resources like black bears and salamanders, or federal-trust resources like migratory birds, all wildlife belongs to all citizens. Because wildlife are public-trust resources, management decisions made by private landowners affect the natural systems in which we live, often beyond our property boundaries; our neighbors; our community; and, especially with migratory species, our nation and beyond. It is important that private landowners think about these multiple perspectives in making land management decisions.

The future of North Carolina's natural resources depends heavily on the decisions and actions taken by private landowners. I hope this publication provides you with information to promote your family's well-being, retain your connection to the land, perpetuate our rich and diverse natural heritage, and maintain a state where our children and our children's children will be grounded in place and want to call that place, North Carolina, home.

David T. Cobb, Ph.D.
Chief, Division of Wildlife Management

January 2010

* Aldo Leopold (1887-1948), a renowned scientist and scholar, is considered the father of wildlife ecology. His book, *A Sand County Almanac*, led to a philosophy that created a "land ethic" based on living in harmony with the land and with one another.

TARHEEL WILDLIFE

A Guide for Managing Wildlife on Private Lands in North Carolina

By Terry Sharpe

Managing a piece of property for wildlife should be looked upon as a process, so enjoy and take pride in each step along the way; whether the result is the first bluebird to take up residence in your newly constructed nest box, the flush of a covey of quail from cover you developed along a ditch bank, or the sight of a gobbler strutting in your freshly burned pine forest.

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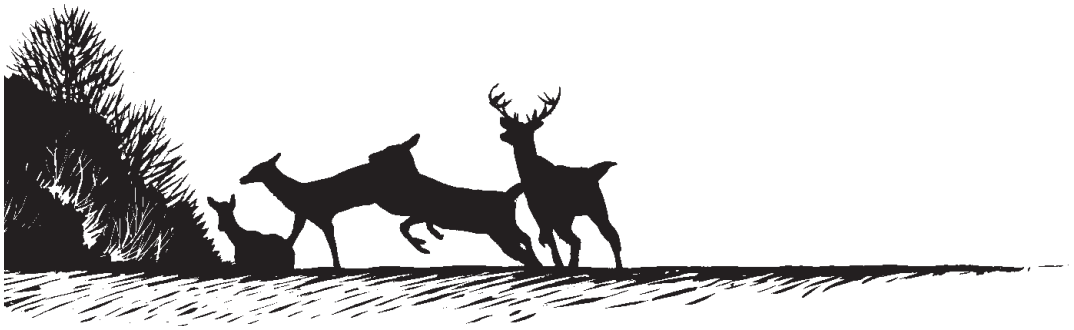
Contents

1 Wildlife and the Land



Perhaps you enjoy the excitement of hunting and the fruits of the hunt, such as venison stew on a cold winter day. Maybe you look forward to the arrival of the first whip-poor-will of spring, the call of a quail on a summer morning, or the hooting of a barred owl at dawn with an answer from a distant wild turkey gobbler. Enjoying wildlife, whether it is the harvest of a turkey or simply watching butterflies visit a blazing-star wildflower, is one of the rewards of managing a plot of land. The purpose of this booklet is to help you with this important and enjoyable task.

Wildlife populations reflect land use and social changes. For example, increased area in short grasses such as lawns, closely grazed pastures and manicured landscapes favor Canada geese, bluebirds, and killdeer, all of which have increased in North Carolina. Meanwhile populations of quail, Eastern meadowlarks, and field sparrows that require *early-successional habitats*, such as tall grasses and fallow areas have experienced long-term declines. Populations of wild turkeys, white-tailed deer, and black bears, once rare because of severe habitat loss and unregulated harvest, have rebounded because of stocking efforts, compliance with well-designed hunting regulations, and the adaptable nature of these species.

The greatest threat to wildlife today is habitat loss and fragmentation due to development and the intensive land use associated with the production of farm and forest products. Though efforts to conserve our wildlife resources are framed by policy decisions at the state and national level, the work must be implemented one woodlot, one hedgerow, and one backyard at a time. If you own a forest, a farm, or a lot and are willing to invest some time and energy into developing and implementing a wildlife management plan, you can enjoy more wildlife. Creating and maintaining wildlife habitat on your property, no matter how small, is an important contribution to the conservation of healthy and diverse wildlife populations across North Carolina.

Why should I manage my land for wildlife?

Our management decisions reflect our personal philosophy toward the land. Aldo Leopold in his book, *A Sand County Almanac*, spoke of the relationship between us and our land. Instead of viewing land as a commodity to be mined for resources, he saw land ownership as a responsibility. This responsibility requires us to use the land to provide for our needs, but, in return, we have the responsibility to leave it in better condition.

We want our land to be productive from an economic or aesthetic sense and, in almost every instance, we can integrate wildlife habitat improvements into other primary land uses. Often, some concessions will be required, but by taking advantage of all the tools at our disposal, we can minimize expenses and sometimes even increase the net value of, or net income from, our property while providing habitat for wildlife. For example, *field borders* can convert low-yielding field edges to conservation buffers that provide annual rental payments; thinned and burned pine forests can produce higher-quality forest products, as well as better food and cover for *early-successional wildlife*; ditch banks managed by spot-spraying problem trees can yield savings on mowing and reduce frequency of maintenance; and a field of wildflowers can provide welcome relief from the monotony of closely cropped lawns.

Actively managing your land for wildlife has a multitude of other benefits including more wildlife, increased opportunities for viewing and hunting, aesthetics, exercise and just having more opportunities to spend time outdoors. The decisions you make concerning land management will depend upon how you rank wildlife objectives in

relation to other objectives, the suitability of your property, and the surrounding landscape in support of your goals. The best news is that many landowners will find the enjoyment attained by having more wildlife well worth any concessions made.

Wildlife-Friendly Practices

Forestland

- Thinning and burning can transform a pine plantation into a more productive area for wildlife.
- Edges where fields meet forest are more attractive to wildlife when a transition zone of brush and shrubs is established and maintained.
- Small canopy gaps can make the interior of hardwood forests more attractive to songbirds and many species of wildlife.
- Felled tree tops and brush piles along woodland edges provide cover for wildlife.
- Woodlots can be protected from the competition of grazing cattle.
- By leaving an occasional island of *mast* producers when harvesting timber, you can provide food resources and create hunting opportunities.

Cropland

- No-till farming, where crop residue remains on the soil surface, can increase profitability, reduce erosion, and enhance the benefits of cropland to wildlife.
- Field borders of native grasses and wildflowers or volunteer vegetation can provide wildlife food and cover as well as annual income from conservation programs.
- Small patches of standing grain along field edges will provide food and cover for wildlife during winter months.

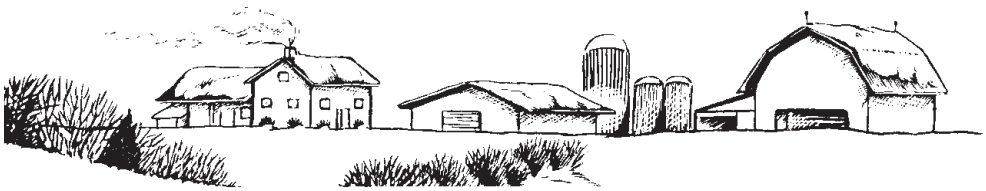
Grassland

- Improved soil fertility will contribute to both wildlife and domestic livestock productivity.
- Native warm-season grasses provide dependable summer livestock grazing during the often hot and dry summer months, while providing food and cover for wildlife.
- Adding a legume to perennial grass pastures and hay lands builds the soil, improves forage for livestock and wildlife, and supports abundant insects on which wildlife feed.
- Burning grass stands is more beneficial to wildlife than mowing because burning results in greater diversity of plants and removes plant litter from the surface of the ground.
- Rotating cattle through different pastures can improve cattle weight gains and wildlife habitat.

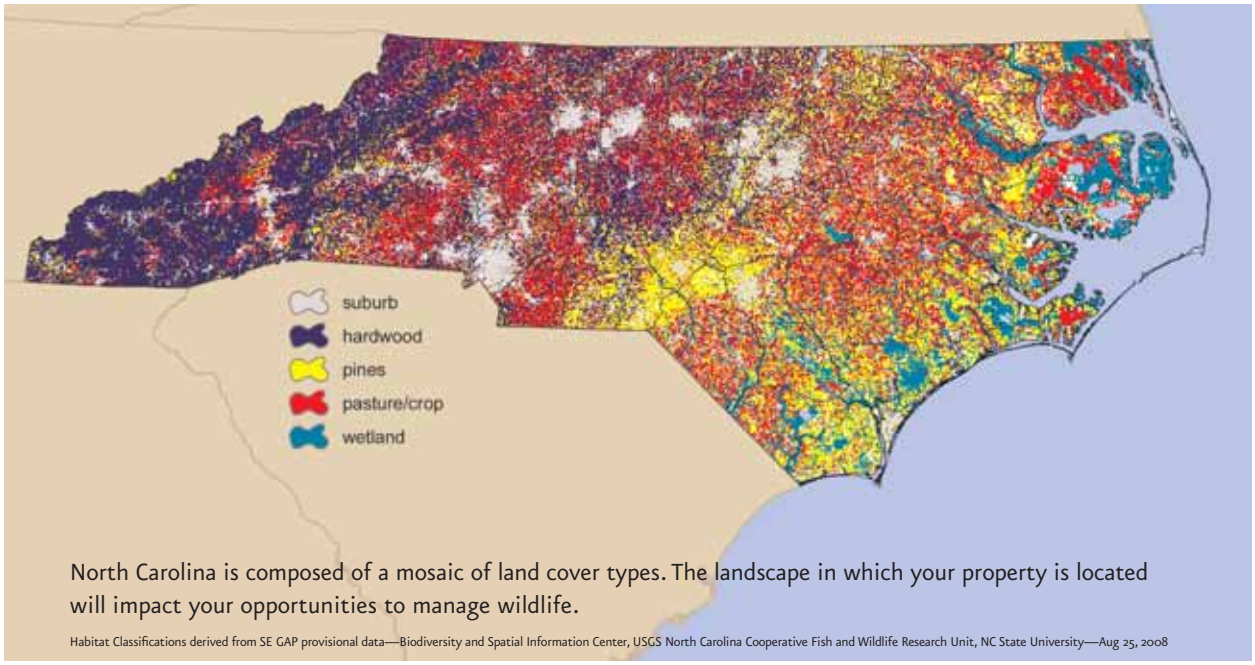
Wetlands and Idle Areas

- Fence stream banks to exclude livestock.
- Managing fencerow and ditch-bank vegetation can increase food and cover on working lands.
- Streamside-management zones that are maintained in mature hardwoods can provide wildlife travel lanes and diverse food resources.
- Existing or constructed temporary pools, which hold water only during portions of the year, are important breeding sites for frogs and salamanders.

2 Land Planning For Wildlife



One of the toughest questions to answer is "Do I need to make changes to meet my wildlife objectives and, if so, how much time and effort will be required?" The answer will usually depend on how well your wildlife management goals fit with the habitat that currently exists on your property and on the land that surrounds it.



North Carolina is composed of a mosaic of land cover types. The landscape in which your property is located will impact your opportunities to manage wildlife.

Habitat Classifications derived from SE GAP provisional data—Biodiversity and Spatial Information Center, USGS North Carolina Cooperative Fish and Wildlife Research Unit, NC State University—Aug 25, 2008

Finding the Right Fit–Ecosystem Management

Following are some common land uses that occur on private lands and a few examples of birds and animals that may benefit from your habitat-management activities. If your property has more than one land use (for instance, farmland and forest), it is important that you consider habitat-management opportunities to benefit the species or group of wildlife species you want to enhance across each habitat type.

Cropland-dominated Landscapes

Quail; mourning dove; common yellowthroat; indigo bunting; field; grasshopper; and savannah sparrows; Northern harrier; barn owl; cottontail rabbit and white-tailed deer.

Suburban Backyard Landscapes

Bluebird; robin; cardinal; American goldfinch; downy woodpecker; red-shouldered hawk; gray squirrel; fence lizard; anole; garter snake; Fowler's toad; and gray tree frog.

Pine Forest Landscapes

Brown-headed nuthatch; pine warbler; Bachman's sparrow; red-headed woodpecker; Eastern wild turkey; cottontail rabbit; white-tailed deer; pine barrens tree frog; Eastern spadefoot toad; Southern hognose snake; scarlet kingsnake; and corn snake.

Hardwood Forest Landscapes

American woodcock; ruffed grouse; downy, hairy, pileated, and red-bellied woodpeckers; northern parula warbler; woodthrush; ovenbird; hooded warbler; black-throated blue warbler; great horned owl; eastern wild turkey; white-tailed deer; gray squirrel; and slimy salamander.

Wetland Landscapes

Wood duck; spotted sandpiper; red-shouldered hawk; barred owl; great blue heron; snowy egret; marsh rabbit; raccoon; muskrat; mink; beaver; ribbon snake; green frog; bullfrog; and a variety of aquatic salamanders.

Making a Wildlife Management Plan

By applying the five-step exercise below, to your wildlife objectives and property characteristics, you can set more realistic wildlife goals, identify changes needed to accomplish these goals, and predict the time, resources, and land you will need.

Step One: First, develop clear objectives for what you want to accomplish on your land.

List what you want to accomplish for wildlife. (Examples may be to harvest larger deer, increase the quail or rabbit population, or see a greater variety of songbirds.) Also list the major economic and aesthetic goals you have for your property. Rank your objectives based on their importance to you. This list and ranking will help you decide what you can realistically accomplish. The higher ranked objectives should be ones that you would be willing to devote the most time, work, and space to accomplish.

Step Two: Study the habitat requirements of the birds or animals you want to feature.

The better you understand the types of plant communities required, home range sizes, cover requirements, and natural history of the species of interest, the better you will be able to develop a realistic management plan.

Step Three: Evaluate the current status of wildlife habitat on your property and the major land uses within a one-mile radius of your property

Draw a habitat map of your property. Designate areas of woodland, cropland, grassland, idle land and wetlands. If there are big differences, divide each of the above categories into sub-units or stands. For example, woodland stands may be composed of mature hardwoods, mature pines, or young pine plantations. (Aerial photography of your property can be obtained from the county tax office, *United States Department of Agriculture Service Center* [USDA Service Center] for your county, or online from Google Earth or the *NRCS Data Gateway* http://datagateway.nrcs.usda.gov/.)

NCWRC

Consider habitat-management opportunities in each habitat type on your property.

Because many birds and animals are area-sensitive, we must consider land uses beyond the boundary of our property when identifying factors that limit the population increase of a species. This means that the potential for a species to occupy any patch of suitable habitat or their potential to reach a greater density increases as the amount of suitable habitat in the surrounding landscape increases. Since few landowners own or control the land uses on an area large enough to support all the needs of a population of birds or animals, we must consider how our neighbors' land use contributes to or detracts from the needs of the wildlife that we want to manage. For example, developing a waterfowl impoundment that attracts large numbers of ducks is more feasible if the impoundment is located near large bodies of water that offer protected roosting sites or a wildlife refuge that provides habitat. Similarly, the potential to successfully manage for birds that require grasslands is better if your property is adjacent to other grassland or open habitats.

By remaining aware of land uses on your property and surrounding land, you can tailor your management to take advantage of opportunities. Examples include retaining mast trees in landscapes where surrounding landowners are clear-cutting, or managing hardwood forests or pine plantations to emphasize escape cover where surrounding lands are managed in row crops or pastures.

Cooperating with surrounding landowners who have common goals or interests can pay big dividends. Whether managing for quality white-tailed deer, quail, or backyard wildlife, the larger the area under similar management the better the results.

On your aerial photos, mark locations where you frequently see wildlife or signs of use by species that you want to manage. This will provide you with a baseline to help measure the results of your efforts. Though your management will be conducted on a specific plot of land, you may find monitoring data conducted on a larger scale helpful in narrowing down your focus and coming up with realistic goals. See Appendix C for the locations of monitoring data that you may find helpful.

Step Four: Identify limiting factors and address them in a management plan.

Armed with the knowledge you have gained by following the steps above, re-evaluate your original objectives in the context of what you have learned about your property and the needs of the species or group of wildlife you want to encourage. Keep in mind that there will be some give and take. Obviously, squirrels whose numbers peak in mature hardwoods can't exist on the same acre with meadowlarks, which need extensive grasslands. Refine your objectives to those that are realistic considering what you know about the wildlife species of interest, your land, and your capabilities.

Now you are ready to develop and implement a management plan to accomplish your objectives. Your plan may require great patience (waiting for a bottomland hardwood forest to mature), or you may need to implement annual management such as thinning, burning, or disking (converting a pine plantation into quail habitat).

Step Five: Evaluation

Measuring progress should be an integral part of any plan. This step can be as simple as keeping a written record of the wildlife you see on your property, maintaining a hunting diary, or taking photographs periodically to document changes in the plant community. Documenting changes should be enjoyable, and keeping good records will allow you to fine tune your management activities. See Appendix C for links to monitoring techniques that you may find helpful.

Because each situation is unique, you may have questions or encounter some twists and turns that complicate developing a plan to meet your goals. If, after studying the suggestions in this booklet, you decide you need additional advice, call the N.C. Wildlife Resources Commission, Division of Wildlife Management at (919) 707-0050 for help contacting a wildlife biologist.

Components of a Management Plan

A good management plan will communicate and help you to clarify your objectives, summarize current conditions, make management recommendations, describe how to measure progress, and provide an implementation schedule:

- The *Property Description* should include the location, topography, land uses, current management, and special or unique features. This section should also describe the landscape that surrounds your property.
- *Management Objectives* will describe your economic, aesthetic, wildlife, and recreation objectives. They should include both short- and long-term objectives and be specific about which wildlife species or group of species you want to benefit.
- The *Resource Inventory* should address the current state of each major field, stand or land use and include information on acreage, soils, vegetation, and current wildlife populations and harvest.
- *Management Recommendations* should state what will be done in each area to meet your objectives.
- The *Evaluation* section will describe how you will measure progress and maintain records to document accomplishments and responses of the plant and wildlife community to your management.
- A S*chedule of Management Activities* will list chronologically, the management and monitoring activities you plan to implement, along with who will conduct the work. The list provides a means to check off tasks as they are accomplished.
- Finally, a *Map* or maps will denote stands, fields, land uses and other important features. It should include features such as streams, fire lines, and sensitive areas. If needed, include more detailed maps to record features on a scale that will allow you to record pertinent information.

Management Examples

Here are examples from the three regions of North Carolina that illustrate how landowners work within the capability of their property and resources to accomplish wildlife objectives:

A FAMILY residing on a 5-acre parcel in the Mountain Region wants to increase the number of species and individuals of songbirds on the property so they can watch and enjoy them. The property was formerly a hay field and is currently mowed and surrounded by other small landowners with woodlots and mowed fields. Their objectives are to create an enjoyable environment to raise children, increase the diversity of songbirds, and help some wildlife species that are not doing well. They study the habitat requirements of various birds and identify the group of birds that requires early-successional habitat as the most reasonable to manage in the landscape that surrounds the property. The group of songbirds that requires grassland and brushland habitats contains prairie warblers, white-throated sparrows, juncos, common yellowthroats, catbirds, brown thrashers, and others. They develop a plan that includes hedgerows of blackberries, small trees, and fruit-producing shrubs, which can also screen the property from neighboring homes. They convert the majority of currently mowed lawn area to a wildflower meadow while retaining a small mowed area with more formal landscaping around the home.

AN AVID DEER HUNTER purchases a 100-acre forested tract in the Piedmont. The land has 60 acres of 10-year-old loblolly pine plantation in which the trees are too thick to produce forest products in a reasonable time frame. The land also includes 10 acres of 40-year-old upland hardwoods, and 30 acres of bottomland hardwood regeneration that is 10 years old. The tract is located in a landscape dominated by pine woodlands owned by forest investment companies. The goals for the tract are to have a place to hunt, increase the quality of deer harvested, and to produce periodic income through timber harvest. After studying the needs of deer, the hunter walks over his land and determines that mast has been abundant during many years in the uplands. However, browse resources are currently limited in the young closed-canopy forests of the upland pine and hardwood bottomland stands. He is able to obtain financial assistance to help with a pre-commercial thinning in the pine plantation. Plans call for 12 feet by 12 feet spacing, which will open up the canopy in the young pines. While the thinning crew is on his property, he has them cut shooting lanes for two deer stands in the pine plantation and open up fire lines on the edge of the pine plantation. He also has them open up shooting lanes for one deer stand in the bottomland hardwoods. In the future, he will contract with a bulldozer operator to clear the fire lines, maintain the shooting lanes with herbicides and cutting, and—following the first commercial thinning—clear the log-loading area to form a 1-acre site for a food plot and initiate prescribed burning. He also meets with leaders of surrounding hunt clubs to discuss opportunities to work together to better manage the deer herd.

A COASTAL PLAIN FAMILY lives on a 40-acre farm that has 30 acres of cropland and 5 acres of young mixed pine and sweetgum forest that backs up to a 5-acre wetland. The family would like the farm to continue to produce income while also providing habitat for a covey or two of quail and provide a place to hunt for deer. The owners obtain aerial photographs and learn that the surrounding land use is predominately row crop farmland. They study the habitat requirements of quail and deer. They learn that enrolling the field borders in a conservation program provided through their local USDA Service Center will allow them to provide weedy habitat that is currently in short supply for quail. They decide to install borders along an adjacent highway to provide quail habitat and a screen to reduce visibility of deer from the road. Additionally, they learn that they can use fire and herbicides to control the sweetgums that compete with more valuable pines along the wetland border. Burning and herbicides will improve the visibility in the woodlands and encourage a groundcover of grasses and *forbs*. They offset a portion of their expenses for installing fire lines and burning with assistance from conservation programs administered by the Natural Resources Conservation Service. By implementing the plan, they can continue to lease most of the cropland, derive annual rental payments from the field borders, and turn the overgrown woodlot into quail habitat while still growing pine saw timber. Their plan will require work annually to maintain the borders and burn.

3 Woodland Management

Forest Succession

At some stages or under some management regimes, forests can provide suitable habitat for a variety of wildlife. Young forests can provide a plant community with structure similar to grassland or old field habitats and, for the first few years, can support early-successional and grassland birds, cottontail rabbits, sun-loving wildflowers and insects. However, unless they are disturbed within a few years, young forests shade out low-growing cover and early-successional wildlife species are replaced by species that feed in the forest canopy or can dig through the litter layer. Other wildlife species cannot exploit the resources provided by forests until trees reach fruit or seed-producing age or until the trees age to the point that tree disease or mortality provides cavities for roosting or nesting.

Forest management decisions have long-term consequences. Informed landowners will seek professional assistance, as well as research the implications of forest management decisions on wildlife. They will weigh those consequences, along with economic and aesthetic considerations, to be certain they have considered the range of management choices. They will consider things such as which groups of species will benefit or be harmed in the short and long term. Are there alternatives that will extend the time the forest is inhabited by target species or that will benefit them from the proposed action? Are there ways to mitigate impact or make maintenance less expensive? Does the action mesh with surrounding landscape features? Well thought-out decisions will result in realistic expectations and management success.

Plan Ahead

Frequently wildlife biologists and foresters are asked to provide technical assistance after a forest stand is harvested. Unfortunately, at that point, the harvest has limited many options for regenerating the stand and improving wildlife habitat. Seek professional assistance from a wildlife biologist prior to initiating a timber sale. Sometimes minor adjustments can be made in the sale area, logging instructions, or contract requirements that can put you years ahead toward meeting goals for your property.

The Wildlife Society maintains a list of certified wildlife biologists and the North Carolina Division of Forest Resources maintains a list of registered foresters who offer consulting for private landowners. These lists can be accessed through www.ncwildlife.org/tarheelwildlife.

Snags and Den Trees

A snag is a standing dead tree. Den trees are live trees or snags with a natural hollow in the trunk or limbs. Den trees can provide homes for a diversity of cavity-nesting birds and den sites for other wildlife. Cavities encourage a variety of wildlife, but if you manage to attain high populations of quail or rabbits, you should consider the trade-off of providing habitat for potential predators (among them raccoons, opossums, and rat snakes).

Many birds, mammals, and reptiles use dying trees and cavities throughout the year for nesting, feeding, perching, escape cover, and protection from the weather. In a typical woodlot, trees with cavities are often in short supply. To have the greatest diversity of wildlife, it is important to protect snags along with existing and potential den trees.

The flush of insects associated with a dying tree are an important resource for wildlife. Some birds use specialized bills to extract insects, while other birds, bats, and lizards are efficient in capturing the insects as they disperse. Once a tree dies, the slow process of decay begins. As the heartwood in a snag softens, woodpeckers excavate nest holes, which are later used by other wildlife.

Woody material on the forest floor can be important feeding areas, offer protection from predators, and help moderate the effects of weather extremes for small mammals, reptiles, and amphibians.

Woodland Edges and Openings

Edge is the transition zone between habitat types. Man-made edges are frequently abrupt and narrow (think of a typical edge where a cropfield meets a mature forest), while natural edges frequently make a gradual transition from one habitat type to another. The most common edges are where woodland meets an opening. This zone offers critical wildlife food and cover. The amount, diversity, and quality of the edge directly affects wildlife food and cover resources.

The edge where cropland meets woodland provides an opportunity to create a gradual transition from one habitat type to another.

High-quality edge consists of a wide band of diverse plants that gradually changes from one cover type to another. It has grasses, weeds, shrubs, vines, and small trees that provide wildlife foods such as berries, seeds, browses, and insects. It also offers cover for nesting and protection from weather and predators, and is wide enough to offer animals many hiding spots. Developing high-quality edge requires deliberate action on the part of the landowner.

A high-quality "feathered" edge can be created as follows: large trees of low commercial value within 30 feet of the crop field should be marketed for pulpwood, removed for firewood, or killed to allow sunlight to reach smaller shrubs; within 15 feet of the crop field, even small trees such as dogwoods, hawthorns, plums, and red cedars should be cut to allow full sunlight to reach the groundcover; when possible and safe to accomplish, vines attached to trees should not be cut when felling the trees.

If you are interested in benefiting a variety of wildlife, kill low-quality trees. If they are in locations that would not create a safety hazard, allow them to stand for snags. However, if you are targeting management to increase quail or rabbits, trees should be felled and the slash used to provide cover or burned. These practices create heavy cover and reduce perch sites and cavities used by predators.

BENY STROPE/NCWRC

Early-succession species benefit from field borders and open canopy forest, which provide escape cover and nesting and brood habitat adjacent to crop fields.

Spot application of herbicide targeting less desirable tree species is an effective way to maintain high-quality edges. The transition zone concept works well along power-line rights of way and access roads, and as a transition between a lawn or landscaped area and woodland.

Frequently, the outside row of trees adjacent to openings has many large and low limbs, which reduce wood quality. By removing these low-quality trees when conducting a commercial thinning, growth is concentrated in more valuable forest products and better wildlife habitat is created along the edge.

Another option to creating a wide transition zone is to allow a 30-foot wide strip of cropland to revert to volunteer plants. The natural process usually is rapid and reliable after the elimination of grazing, plowing, and mowing. However, the field edge transition zone will require periodic management to prevent it from growing into mature woodland. Conversion of heavy sod, such as fescue, to edge habitat can be hastened by applying herbicide to the border strip and plowing or disking, which allows native species to invade.

Pine Forests

Pine forests are adapted to a variety of sites and are often favored by landowners because they produce valuable forest products more rapidly than hardwood forests. Pine forests are often thought of as poor wildlife habitat, but they can be managed to provide high-quality habitats. Habitat quality is a reflection of how pine stands are managed.

The key to having pine forests with abundant wildlife is frequent disturbance. Tools that are useful in managing pine forests for wildlife are thinning, burning, herbicides, and soil disturbance.

TERRY SHARPE/NCWRC

Open-canopy pine forest managed with timber harvest, midstory hardwood control and frequent fire.

Even Age vs. Uneven Age Management

Pine stands are often managed as units in which trees are of similar or "even" age. Stands are planted, managed, and at some point harvested by clear-cutting. Though even-age management is common, it is not the only option for managing a pine forest. Managing pine forests that have trees of many ages in the same stand involves trade-offs but provides many benefits. Stands managed by uneven-age management can accommodate a wider variety of wildlife, including animals that benefit from features provided by older stands (such as mast and cavities) and younger stands (such as groundcover) through time. Another advantage of uneven-age management is that income is spread more evenly through time. The disadvantages of uneven-age management are that the time required to manage the stand is greater, marketing of forest products is more challenging, and prices paid may be lower because harvest is less efficient.

Even-age pine forest management units of 10 to 50 acres are large enough to be practical from an economic standpoint, but small enough for species like deer and turkeys to move among stands to take advantage of resources. Consider breaking large even-age stands into smaller management units of different ages. Trees from around age five until the first thinning are less productive for wildlife and almost unhuntable. Having multiple age classes allows you to avoid extensive stands of trees of the same age, increases diversity, and provides multiple habitat types for many wildlife species.

Early-Rotation Pine Management

Young pine trees need lots of light. This means regenerating pine stands provide an excellent opportunity to manage for early-successional wildlife. Most pine plantations are planted following clear-cutting or during conversion of agricultural fields to woodlands. However, pine stands can be regenerated by cutting openings in a stand of mature cone-bearing trees, and burning or disturbing the soil mechanically. Regenerating pine stands that are managed to benefit wildlife should have a high component of grass, forbs, and shrubs interspersed among the young trees.

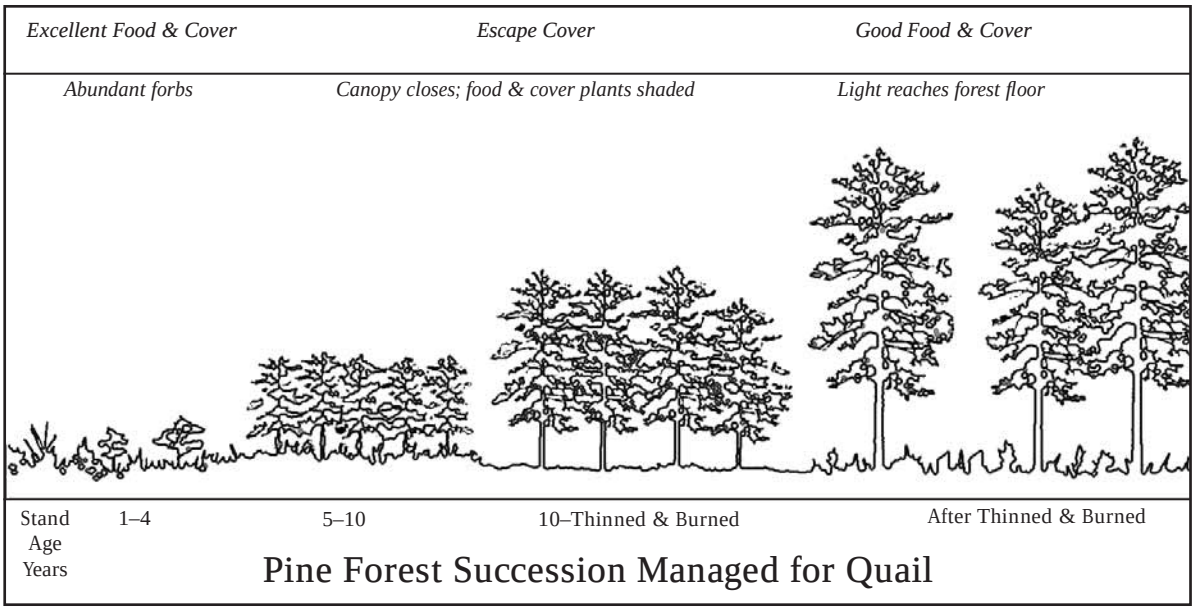
Preparing a site for pine regeneration can range from simply planting following harvest of a mature stand to intensive site preparation, which can include combinations of herbicides and or mechanical treatments to control competition. If no site preparation is used, regenerating hardwoods often suppress grasses and forbs and compete with the young pines. When a management goal is to favor wildlife, some moderate form of site preparation to control hardwood sprouts and to disturb the litter layer is desirable to encourage a diverse grass and forb plant community.

Site preparation techniques that are appropriate where wildlife is a consideration include burning, mechanical site preparation, or a single herbicide treatment to control competing hardwoods. Herbicide applications that effectively control herbaceous weeds and grasses across the whole stand result in poor wildlife habitat. In the few instances where herbaceous weed control is necessary for the survival of seedlings, a spot treatment around individual plants or a band treatment over rows will provide better wildlife habitat than broadcast applications. One exception to this rule is where perennial grass fields (Bermuda, Bahia, or fescue) are being planted to trees. Broadcast herbicide treatments to eliminate exotic grasses should be applied prior to planting these areas.

It is important to consider soil characteristics. For example, if intensive chemical site preparation is used on infertile soils, little groundcover develops before canopy closure. Young pine stands without a diverse component of grasses and weeds growing between the trees offer few benefits to wildlife.

If hardwoods in the pine stand were not controlled at planting, consider herbicide release when the pine stand is two to three years old. The herbicide, imazapyr, can be applied to the stand (often by air) to control hardwoods. When applied according to label instructions, this herbicide will not harm pines and some important wildlife plants (legumes and blackberries) will persist.

Tree spacing is an important consideration. Planting seedlings too closely causes the canopy to close quickly and blocks sunlight from the groundcover plants that are important for wildlife. Close planting also results in small diameter and slower-growing trees. Planting seedlings excessively far apart results in trees that grow quickly but develop large branches making them less valuable for forest products. Frequently used spacing that allows for rapid early growth, acceptable pruning, and good wildlife habitat is 10 feet by 10 feet (436 trees per acre) or 10 feet by 12 feet (363 trees per acre) between trees for all pine species (except white pines which are typically planted at 12 feet by 12 feet). Wider spacing may be appropriate where commercial thinning will be difficult to accomplish due to markets or terrain. However, in very open stands lower limbs may not prune naturally, and the resulting large limbs will lower the quality of forest products being produced. To produce high-quality forest products, hand pruning or pruning by prescribed fire may be required where spacing is wider than 12 feet by 12 feet (302 trees per acre).



Pine Forest Succession Managed for Quail

Visit *www.ncwildlife.org/tarheelwildlife* or see Appendix D for links and more information.

Which Pine?

North Carolina supports a variety of pine species, each of which is adapted to specific soil or site conditions. Longleaf pine is adapted to a wide range of Coastal Plain soil types, as well as southern Piedmont upland soils. As an adaptation to frequent fire, longleaf often spends several years pumping energy into the root system and then undergoes a quick growth spurt to reach a fire-resistant stage. Controlling competition is critical to establishing longleaf on fertile soils that do not have a history of frequent burning. Prescribed fire is used frequently in young longleaf stands to control competition from hardwood and other pine species and to benefit wildlife. Where wildlife is a consideration, fire is a critical component of managing young longleaf stands.

In addition to being more fire-adapted, the canopy of a longleaf pine forest is more open compared to loblolly forests; therefore, longleaf allows more light to reach groundcover plants. Longleaf has large seeds that wildlife prefer, and it is well suited for uneven-age management. When compared with other pine species, longleaf produces dense wood and straight trees that yield high-value forest products.

Loblolly pine is the most frequently planted pine species in the state. It is fast growing and produces quality forest products on many soil types. It is not as fire tolerant as longleaf when young, but, after the first commercial thinning, it can be managed aggressively with fire to provide excellent wildlife habitat.

The native pine over much of the Piedmont is the shortleaf pine. The shortleaf pine produces excellent quality poles and saw timber. Shortleaf is intermediate between longleaf and loblolly in its adaptation to fire. Young saplings will resprout if top killed, and the species quickly develops thick bark that allows it to withstand low-intensity fires. Open-canopy stands that are frequently burned provide excellent wildlife habitat.

A common mountain pine, the white pine, is less fire tolerant than most other species and unlike other pines is generally not managed with prescribed fire. However, white pine responds well to thinning and can be managed on a long rotation to produce high-quality saw timber. Because white pine is a long-lived species, landowners also have the option of managing for mixed stands of planted white pine and commercial hardwood such as oak. By planting their pines wider than the usual 12 feet by 12 feet and allowing natural hardwood regeneration to develop along with the pine, a landowner has the opportunity to improve the productivity of the stand for wildlife and still produce high-quality timber products. Although a greater commitment of labor is required to successfully manage a mixed oak and pine stand, it will mature into a stand with both food and cover for wildlife. Another plus is that mixed stands generally have more ground cover than single species white-pine plantations, which often have nothing but pine needles on the forest floor. Mature stands of white pine provide thermal cover in winter and are often favored by wild turkey as roosting sites. Diverse flocks of winter songbirds (kinglets, chickadees, pine warblers, downy woodpeckers) can frequently be found feeding in white pines. Deer use younger white pine stands for bedding and hiding cover, and as shelter from winter storms. Green white pine cones are eaten by squirrels as frequently evidenced by piles of cut cones.

Less frequently planted pine species include the pond pine, adapted to organic soils of the Coastal Plain and Sandhills; the Virginia pine, which proliferates on disturbed sites in the Piedmont but produces low-quality forest products; and pitch and table mountain pines, both of which are well-adapted to fire and naturally occur on the thin soils of south-facing slopes in western North Carolina.

Mid-Rotation Pine Management

Young pine stands provide poor wildlife habitat from the time that the canopy closes until the first thinning. Groundcover plants suffer not only because the tree canopy prevents light from reaching the ground, but also because a smothering layer of *duff* builds up on the forest floor. The key to rejuvenating these stands is to implement practices that restore light and remove litter from the forest floor.

If pines are spaced closer than 10 feet by 10 feet, consider a mechanical pre-commercial thinning with brush saws while the trees are five to 12 years of age. In most areas, first commercial thinnings are viable at stand age 12 to 20 or when trees reach six to eight inches in diameter. Thinnings remove suppressed and poorly formed

trees, as well as trees with large and low limbs along edges. They also and space the crop trees that are left so they can take advantage of additional space, sunlight, and nutrients. First commercial thinnings of young pine plantations can be made to 65-75 square feet of *basal area* (BA) per acre for normal forest management practice. This type of first thinning will allow trees to increase in diameter while still maintaining close-enough spacing for larger lower limbs to prune naturally. In addition, the trees can help to support each other in high winds and ice. Heavier first thinnings (40-60 BA) can be made for intensive wildlife management and to create early-successional habitat for species like quail, but landowners may need to prune trees which sprout larger and more numerous limbs under thinner regimes. Many cost-share programs are available to assist landowners with these heavier wildlife-friendly thinnings. (Check with your local USDA Service Center or North Carolina Wildlife Resources Commission biologist.) Under either scenario, trees respond quickly and, within a few years, a second thinning to a basal area of 40-60 square feet per acre (closer to 40 square feet per acre if managing for quail) will set the stage to provide excellent wildlife habitat while producing high-quality forest products.

Immediately following the first commercial thinning is an excellent time to begin a prescribed burning program (except for white pines). Instruct loggers conducting the thinning to pile logging slash away from live trees to prevent damaging them during prescribed fires. If fire lines were not planned and installed when the stand was regenerated, remove trees on the stand perimeter during the thinning to make room to install a permanent fire line. Flat, bladed fire lines of a minimum of 10 feet wide are preferable to fire lines plowed with a dozer/fire plow designed to fight wildfires. Once bladed fire lines are established, they can be economically maintained with farm equipment.

JEFF MARCUS/NCWRC

Thinning and frequent prescribed fire promotes a diverse groundcover that supports grassland birds and other early-successional wildlife.

Wildlife Management Tips for Pine Forests

- Thinning and burning can transform a pine plantation into a productive area for wildlife.
- Include fire or soil disturbance when preparing sites for replanting.
- When establishing pine forests, control hardwood competition and exotic grasses but not herbaceous weeds and native grasses.
- Use spot- or strip-herbicide applications instead of broadcast applications to control herbaceous competition in young stands (except broadcast herbicide to control exotic grasses).
- Plant on 10 feet by 10 feet, or 10 feet by 12 feet spacing.
- Plant longleaf or shortleaf pine on appropriate sites.
- Install firebreaks around the stand at the time of establishment.
- If pine spacing is closer than 10 feet by 10 feet, consider a mechanical pre-commercial thinning with brush saws.
- Work with a forester to commercially thin stands as early as feasible.
- When regenerating or thinning pine stands, install bladed fire lines that can be easily maintained.
- Reintroduce fire into the stand at an early age; after 1 to 3 years for longleaf or when other pine species are commercially thinned for the first time.
- Maintain an open canopy by thinning frequently.

Late-Rotation Pine Management

Frequent disturbance through the life of the stand is critical to maintaining quality wildlife habitat in pine stands. Thin pine stands every five to 10 years to maintain an open canopy. If managing for quail, thin to the point that 60 percent of the forest floor receives sunlight at midday on a summer day. This translates to a basal area of 40 square feet per acre. This very open stand is necessary to encourage the cover of grasses and forbs needed to screen quail from aerial and ground predators. Once prescribed fires are initiated, you should continue to burn frequently throughout the life of the pine stand. If managing to encourage quail, burns should be conducted annually until herbaceous cover becomes established. Burn thereafter on a two-year rotation in blocks ranging from five to 50 acres in size. If deer and turkeys are your target species, thin to a basal area of 60 square feet per acre and burn on a two- to four-year rotation.

Hardwood Forests

Hardwood-dominated forests and woodlots provide great potential as habitat for a variety of wildlife species. Older stands provide mast and den trees for squirrels and furbearers and seasonal habitat for deer and turkeys. They also provide habitat for a variety of migratory songbirds (warblers, vireos, wood thrush, woodpeckers, and many more) that take advantage of the vertical structure of habitats ranging from the forest floor to tree canopies. Young hardwood stands, forest edges, and openings produce browse and dense cover for deer, habitat for grouse and woodcock, and nesting areas for many songbirds. The difference between a hardwood stand that provides good wildlife habitat and a poor one may be nothing more than a fence to exclude livestock, creation of a few canopy gaps, or a timber stand improvement cut.

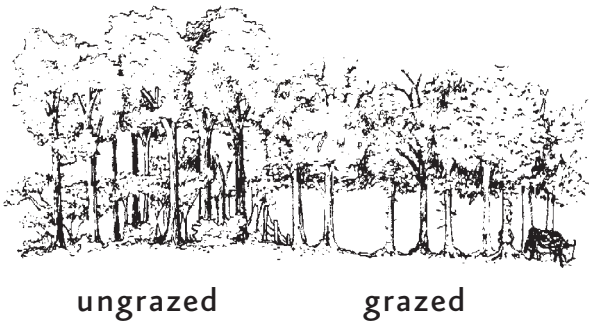
Oak Glades and Savannas

When we think of prescribed burning, we typically think of grasslands and pine forests, but fire can play a role in managing upland hardwood stands. Fire and thinning can be used to create an open oak glade or oak savanna with an herbaceous understory. In fact, thinning the overstory and burning is a simple way to increase browse as well as stimulate seed production and cover provided by groundcover grasses and herbs. Managing for savannas and glades is most appropriate on shallow soils and in hardwood communities with a high percentage of oaks and hickory. Small diameter stems as well as maples, poplars, cherry, holly, sweetgums, and other species with thin smooth bark are not very fire tolerant, so fire in hardwood stands will favor oak and hickory.

Hardwoods and Livestock

Grazing livestock do serious damage to woodland habitats over time. Much of this damage is not immediately visible and shows up only as long-term effects, such as loss of groundcover and regeneration, tree decline and loss, soil erosion and compaction, and wildlife habitat destruction.

Tree seedlings and saplings, wildflowers, and understory shrubs are eaten or destroyed. Saplings are broken, stripped of bark and trampled. Even large trees suffer wounds from rubbing and chipping of hooves at the base of the tree.



Grazing livestock do serious damage to woodlots over time.

With heavy use, livestock hooves mix the leaf litter into the soil speeding decomposition and exposing bare soil to erosion. The pores in the soil that allow air and water to move down to tree roots are sealed off. Rainwater that should infiltrate into the soil runs off the surface. The fine, hair-like feeder roots located several inches under the ground are exposed and damaged. Trees become weakened and growth rate is slowed. Damaged and exposed tree roots are excellent entry points for insect and disease pests.

Often, trees that are resistant to grazing increase in number as the less resistant but more valuable trees are eliminated. Hickories, with their tap root, can tolerate more soil compaction than oaks and will increase in number at the expense of oaks. Because there is little grass for cattle to eat in the woods, plants are consumed from the ground up to as high as the cattle can reach, creating a browse line. Wildlife requiring groundcover and low-growing plants cannot survive in grazed woodlands.

To return grazed woodland to good wildlife habitat, fence out livestock. Check with your USDA Service Center for possible cost-share programs to help offset fencing costs. Similar reductions in groundcover quality and diversity can also occur where deer populations exceed the *carrying capacity* of the habitat.

Crop Tree Release

Crop tree release (CTR) is the process of removing selected trees from a forest to improve the health and growth of other trees and to benefit wildlife. The remaining trees are selected because of their potential to produce high-value wood products or to benefit wildlife. CTR can be adapted to meet many management objectives, but, in general, the purpose is not to remove every defective tree, but to reduce competition from selected trees with desirable characteristics.

Step one is to identify a dominant tree that has the potential to produce valuable wood products or mast. Step two is to cut or kill adjacent trees whose crowns crowd the desirable tree. For most purposes, efforts should focus on killing only those trees that are in direct competition with the crown of the selected crop tree.

Species selection and proper spacing of trees are key to any CTR operation. Trees spaced too closely will soon become crowded, slowing their growth. Trees spaced too far apart encourage larger crowns, sprouting of new limbs on the trunk, and larger limb diameters at the expense of taller straighter trunks.

When conducting a CTR, the most important trees to leave uncut are the final harvest trees or crop trees. These trees will have the highest value as wood products. Other trees to leave standing are those that will be removed in future thinnings but are needed in the meantime to fill growing space and mast trees. Midstory mast producers such as cherry, dogwood, serviceberry, and black haw can be left for wildlife unless they overtop potential crop trees.

Detailed information on planning and conducting a CTR, including guidelines on the number of crop trees to retain, species composition, the influence of stand age and other considerations, is contained in the publication *Technical Guide to Crop Tree Release in Hardwood Forests* (University of Tennessee Extension).

Canopy Gaps

Canopy gaps add to the importance of true old-growth forests to wildlife. A common problem that limits wildlife in young to middle-aged hardwood stands is development of a uniform canopy. Lack of sunlight inhibits midstory shrubs and vines and shades out low-growing plant communities. Hardwood forests with a uniform canopy can lack the variety of plant communities necessary to support some wildlife populations.

JEFF MARCUS/NCWRC

Creating small gaps in the overstory can add diversity to closed-canopy hardwood stands.

Creating gaps in the canopy can create low cover and provide more diverse habitats. A commercial thinning or mechanical or chemical croptree-release operation can be used to create gaps.

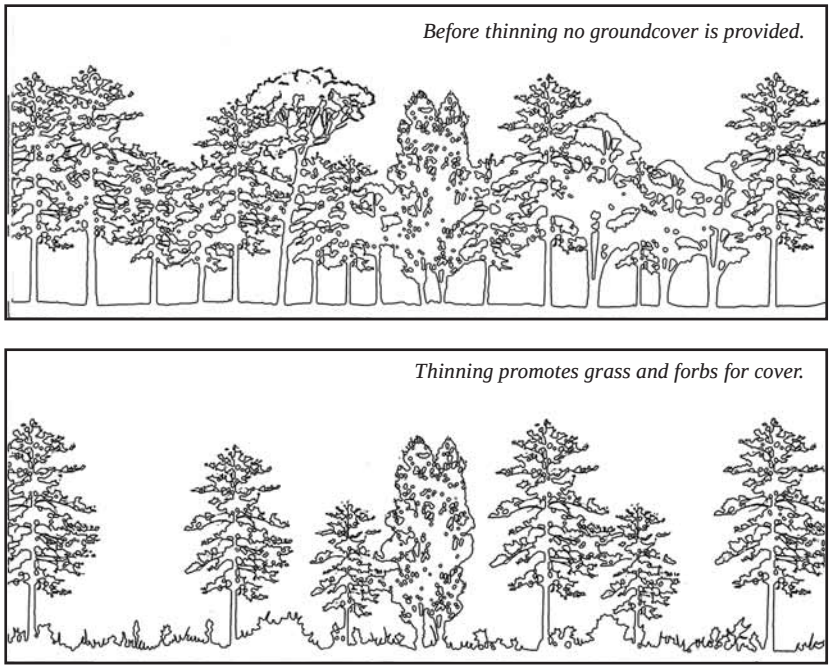
Leaving standing snags will make the gaps attractive to a wider variety of birds. When working in large tracts, leave a variety of hardwood tree species and vary the size of gaps from single tree gaps to gaps up to one acre in size. Five to 10 acres of small gaps per 100 acres of woods is desirable. This practice benefits many forest bird species and can be used to regenerate commercial tree species, create shooting lanes, areas of dense escape cover, and browse.

Timber Harvests in Hardwood Forests

Assess the current condition of the timber stand with a registered forester or wildlife biologist prior to initiating a timber harvest. During the assessment, determine tree species present, quality of the stand, growth rates, current and future value to wildlife, and forest regeneration options. Discuss management options including your long-term economic goals, wildlife goals, and practical considerations such as access and market conditions. Carefully consider all the options including clearcutting, thinning, and letting trees grow without additional management before initiating a timber sale.

Challenges to managing a hardwood forest include obtaining and maintaining a desirable species composition, controlling competing vegetation and, in some areas, reducing the impact of deer on regenerating hardwoods. In the past, many existing hardwood stands have been subjected to "high grading," a timber-management practice that removes the better formed and more valuable trees and leaves trees that are poorly formed or of species that have lower economic value. Developing a management plan to correct these problems requires an assessment of the current status of the stand and a prescription for regeneration. For assistance in developing a management plan for a hardwood stand that provides for future wildlife habitat and meets your economic goals, work closely with a registered forester and wildlife biologist.

Lone mature trees left standing in clear cuts suffer high mortality rates. If you wish to retain hardwoods for mast production, diversity, or to provide hunting opportunities in an area that is being harvested, consider leaving one- to two-acre islands of hardwoods. Trees in these hardwood islands will survive better than scattered individual trees and will also offer excellent sites for hunting while the next forest is developing. Planning these hardwood islands adjacent to food plots or regularly maintained shooting lanes can be an excellent way to assure that you have a place to hunt during the years that visibility in the young regenerating forest limits hunting opportunities.



Low-growing grasses and herbs that provide food and cover require sunlight to prosper.

Wildlife Management Tips for Hardwood Stands

- Protect woodlands from grazing livestock.
- Kill selected trees along woodland edges to create wide transition zones.
- Manage a 30-foot wide strip as a transition zone of forbs, grasses, shrubs and small trees along mature woodland edges.
- Create small gaps and openings within large blocks of hardwoods to encourage regeneration, vines, and fruiting shrubs.
- Apply timber-stand improvement practices.
- Construct large loose brush piles when cutting firewood.
- Introduce fire to create savannas and glades on appropriate sites.
- Install nest boxes where there are few natural cavities.
- When thinning, leave a variety of species of trees including fruit producers such as hackberry, black cherry, red mulberry, serviceberry, black gum, and persimmon.
- Protect existing snags and den trees.
- Kill undesirable trees but leave them standing to create snags of various sizes to benefit a variety of species. Snags along forest edges will benefit different wildlife from those in forest interiors.

4 Cropland Management

Value of crop fields to wildlife fluctuates throughout the year depending on the cover or food resources in the field and the needs of wildlife. Developing crops and waste grains provide a significant resource to wildlife ranging from songbirds to black bears. Conservation tillage or no-till makes a positive impact on wildlife habitat. Benefits include improved water quality, availability of waste grain, retention of cover in fields, and increased populations of invertebrates that are important food for young turkey, quail, and many songbirds.

Research on quail under field conditions found that, unlike some pesticides used in the past, those insecticides legally used on North Carolina farms today have little direct effect on the health of quail chicks. Today's pesticides (insecticides and herbicides) are more likely to impact wildlife indirectly by altering suitable cover and the available food supply of insects in cropfields.

Opportunities can come in unexpected places. Farmers in both the southern Piedmont and northern Coastal Plain have recently recognized wildlife benefits from innovations in cotton stubble management. By leaving harvested cotton stalks standing and either top-sowing small grain or no-till planting spring crops into standing stalks, farmers have cut fuel costs and and added structure and cover provided by the harvested stalks to the landscape. By reviewing your cropping system with cultural, economic and wildlife goals in mind, you may find adjustments that will better accommodate your wildlife goals while meeting cultural and economic goals.

Crop Rotation

Crop rotation consists of planting different crops in a field from one year to the next. Long-term crop rotation means planting three or even four different crops before returning to the original crop. These practices increase the health of individual crops and add plant diversity to the land. Continuous cropping means that the crops in a field do not change each year. Crop disease experts report that the highest risk for crop diseases results from continuous cropping. Insect problems also are more prevalent under this system, so more pesticides are needed. Many corn and soybean diseases and associated pests can be controlled by a simple crop rotation.

Legumes always are a good choice for rotation because they add nitrogen to the soil and reduce fertilizer requirements for next season's crop. Legumes can also make ideal wildlife nesting cover and food if mowing is delayed until late summer. Clovers can be seeded into row crops after the last cultivation to reduce erosion, add nitrogen, and provide wildlife cover during the winter.

Small-grain crops such as wheat, rye, and oats provide nesting cover throughout the spring and summer. The stubble of these crops, cut high and left undisturbed or planted to no-till soybeans, makes excellent brood-rearing habitat for quail.

Visit *www.ncwildlife.org/tarheelwildlife* or see Appendix D for links and more information.

Drainage Ditches

Drainage ditches perform the critical function of removing water from cropped lands and are a prominent feature on North Carolina farmland, particularly in flat eastern North Carolina landscapes. Ditches also function as narrow wetlands, provide nest sites and cover for wildlife, serve as corridors allowing species needing cover to access cropland, and provide staging areas for wildlife to occupy when crop fields are deficient in cover. Often the value of ditches to wildlife can be enhanced with minor variations in maintenance and management.

MARK D. JONES/NCWRC

The value of drainage ditches to wildlife can be enhanced by buffers of planted or volunteer vegetation.

Ditch banks provide the foundation that supports many early-successional birds in agricultural landscapes. Ditches support a vibrant wildlife community, including birds, rodents, rabbits, furbearers, reptiles, amphibians, fish, and aquatic organisms that would otherwise be absent from crop fields. Research conducted by North Carolina State University and the North Carolina Wildlife Resources Commission confirmed that fields with bands of natural cover along ditch banks have more quail and wintering songbirds than nearby fields with closely mowed ditch banks.

Approach ditch-bank vegetation management with an integrated pest management (IPM) philosophy. An increasing variety of herbicides is labeled for aquatic use and provides the opportunity to control a broad spectrum of tree species on ditch banks. Examples of herbicides with aquatic labels are Rodeo (glyphosate), Habitat (imazapyr), and Garlon 3A (Triclopyr).

Consider controlled drainage on level land. This practice uses drop boards to manage water levels. Drop boards allow the farmer to hold water in field ditches, which provides more water for crops, reduces nutrient discharge, and increases the value of ditch habitats to aquatic species. Boards are removed to dry fields during wet periods and to allow equipment access for planting and harvest.

The preferred alternative for managing vegetation on ditch banks is to selectively remove trees with herbicides while leaving low-growing plant communities to filter runoff, provide habitat for wildlife, and to hold ditch bank soils in place.

If you must mow, time ditch-bank mowing to avoid nesting season (April 15-Sept. 15). Save time and fuel by mowing in alternate years, leaving cover on some ditches each winter, or by targeting problem trees with spot-mowing while leaving low-growing grasses, shrubs, and forbs. Mow high and leave 10 to 12 inches of stubble. This provides some cover for wildlife and prevents scalping, which can lead to sloughing ditch banks and more frequent maintenance.

Water quality researchers have found that a 20-foot buffer of volunteer vegetation along ditches will remove the majority of nutrients from most North Carolina crop fields. Backing crops off ditches even a few feet helps to filter nutrients and can reduce ditch maintenance by preventing sediment from entering the ditch. However, sheet flow of water across buffers must be maintained to effectively remove nutrients and sediments. It is critical to have fields properly sloped and buffers well maintained. Hoe drains, or areas of concentrated flow from the field into the ditch, defeat the water quality benefits of ditch-bank buffers.

Field Border Systems

Wildlife benefits aside, a good case can be made to implement field border systems based on profitability on many farms. Researchers have studied many aspects of field border economics. They learned that field edges are often the least productive areas in the field. In some cases, the cost of soil preparation, seed, fertilizer, chemicals, and harvest exceeded the value of the crop produced. Field borders did not appear to contribute to major pest problems from weeds or insects and may enhance beneficial insect populations. Crops adjacent to field borders managed for wildlife did not experience reduced yields. These considerations, along with the fact that border establishment can produce annual rental payments through USDA conservation programs, suggest that landowners can turn unproductive field edges into income-producing areas. Finally, quail populations were found to double on Coastal Plain farms with field borders when compared to similar farms nearby without borders. Field borders also were found to provide important habitat benefits to several species of declining songbirds.

Quail, and a host of songbirds, can benefit from field borders of volunteer vegetation. Borders typically volunteer in ragweed, goldenrod, asters, and other forbs and quickly develop into nesting and brood habitat. Borders can be created by simply allowing a strip of cropland adjacent to the field edge to go fallow or by planting a mixture of native grasses and forbs. If initially bare, borders can be planted in an annual grain crop such as sorghum or wheat and then allowed to develop into volunteer vegetation. Borders that run parallel to the row direction are easier to maintain and are less likely to be damaged by farming activities. Borders are beneficial in any cropping system but are most productive when integrated with no-till grain farming and forest-management practices that encourage groundcover.

TERRY SHARPE/NCWRC

Yields are often lower where crop fields border mature woodlands.

Narrow borders can be ecological traps since they attract nesting birds, but are easy for predators to hunt efficiently. Research in southeastern North Carolina found that field border systems were more beneficial to nesting birds in agriculture landscapes than in forested landscapes. Fallow habitats arranged in blocks were more effective than narrow linear field borders. The benefit of arranging habitat in blocks was especially important in forest-dominated landscapes.

Borders require maintenance. A combination of spot-spraying invading trees and disking on a two- to three-year rotation will keep borders in productive plant communities. Disking in fall or winter usually results in plant communities that provide more foods and better structure than disking in spring or summer.

Field borders between 30 to 120 feet in width may be eligible for enrollment in USDA conservation programs. Qualifying borders are eligible for cost-share for establishment and annual rental payments. Check with your local USDA Service Center for more information.

Contour Strip Cropping

The practice in which row crops are planted in strips along the natural contour of the slope and next to a grass or fallow strip is referred to as contour strip cropping. It provides erosion control and plant diversity.

The strips of grass, legumes, or small grains act as a filter that traps sediment and slows water runoff. The strip width is dictated by the severity of the erosion problem and the slope of the field. Where erosion is severe, permanent grass strips should be maintained between strips of crops. These strips should be seeded to a mixture that is beneficial to wildlife. Seeded strips serve as travel lanes and cover for wildlife. These strips also provide nesting and roosting cover and ideally should be maintained by burning in early spring on a two- to three-year rotation.

Cropland Wildlife Management Tips

- Field borders can be used to straighten field edges and eliminate short rows.
- Field borders have less impact on farming practices when placed parallel to row direction.
- Field borders of diverse perennial forbs and native grasses support higher insect populations than borders of volunteer vegetation.
- Spot-spraying encroaching woody plants with appropriate herbicides and disking on a two- to three-year rotation will maintain borders for early-successional birds.
- Control fescue, Bermuda, and Bahia grass prior to establishing borders for wildlife.
- Integrate field borders with woodland edge practices like *edge feathering*, fell and leave, and heavy thinnings.

5 Grassland Management

North Carolina supports a variety of planted and natural grassland habitats ranging from coastal marshes to pasture and hay land, to lawns and mowed rights of way, to young forest regeneration areas, to mountain balds. Wildlife needs can be encompassed in management objectives in all of these grassland types, but, as in most other habitats, the importance of wildlife in landowner management objectives will dictate opportunities.

The list of wildlife that will benefit from improved management of grasslands is long. Meadowlarks and sparrows including field, grasshopper, Bachman's, and Henslow's sparrows are open grassland nesters. Rabbits, quail, turkeys, and deer use grasslands extensively. A variety of reptiles, amphibians, and beautiful butterflies are dependent on grass-dominated habitats. Grasslands benefit aquatic wildlife by controlling soil erosion.

Birds that depend on native grasslands are declining at a rate greater than any other group of North American birds. Many declining grassland bird species depend on large areas of habitat and will benefit most where management activities are applied on a large scale or in expansive landscapes. For instance, one grassland bird, the Bachman's sparrow, occurs almost exclusively in large open-canopied and frequently-burned pine stands with a high grass component or in very large (greater than 100 acres) pine-regeneration areas with a high grass component.

Much of North Carolina's 2,000,000-plus acres of grasslands are managed to produce forage. Unlike extensive grassland ecosystems of the Midwest, our grasslands are often interspersed with woodlots, residential areas, and row crop lands. Opportunities to benefit declining grassland birds are greatest in those areas where grasslands occupy a significant portion of the landscape. (See the N.C. cover map on page 9.)

Management is necessary to keep grasslands productive. Without some type of disturbance, grasslands become choked with dead stems and litter and, on most sites, will revert to forest. Five management tools commonly used in grassland management are grazing, haying, fertilizing, overseeding with legumes, and prescribed burning.

Warm- and Cool-Season Grasslands Dominated by Introduced Grasses

Today, most privately owned grasslands are planted to non-native grasses to produce forage, manage nutrients as part of a waste disposal system, or for aesthetics. Introduced grasses are popular with farmers because they are easy to establish, withstand heavy grazing, and respond to heavy fertilization.

Cool-season, non-native grasses include tall fescue, orchard grass, and timothy. Cool-season grasslands predominate in the northern Piedmont and Mountains. Non-native, warm-season grasslands, which predominate on the Coastal Plain and southern Piedmont consist of Bermuda and Bahia grass. Non-native grasslands are typically managed as short (less than six inches tall) monocultures. Turkeys, deer, and geese will use these grasslands, but grasslands dominated by non-native grasses provide poor habitat for most species of declining wildlife because they are deficient in cover, produce a thick sod at ground level, and produce few seed foods.

The predominant cool-season grass used in North Carolina is fescue. Fescue provides good grazing during the fall and spring. However, many varieties of fescue seed carry within them a fungus, which produces toxins in the

plant. The fungus benefits the plant by discouraging browsing by insects and animals. The toxins in fescue can impact livestock health and weight gains and have been shown to be detrimental to wildlife.

Cool-season grasslands can be improved by overseeding with legumes such as clovers and annual lespedezas. The legumes remove nitrogen from the air and add it to the soil where it is then available for other plants. Pastures overseeded with legumes will provide improved livestock performance and provide greater benefits to wildlife. The addition of a legume to fescue pastures will also help offset the toxic effects of the fungus, which infects many varieties of fescue. Consult your USDA Service Center for recommendations on legume varieties, seeding dates, and methods.

Grasslands planted to warm-season-introduced grasses can be improved by overseeding to a winter annual grass such as oats, wheat or rye. The annuals will provide forage during the period when warm-season grasses are dormant. Here again, consult your USDA Service Center for recommendations on seeding dates and methods.

Introduced grasses are usually hayed or grazed to a height of two to four inches. Grasses below this height will result in lower production, increased soil erosion and less wildlife use. Grazing can be continuous or rotational. Continuous grazing is where all animals are placed in one pasture and allowed to selectively graze. Rotational grazing may be as simple as switching livestock between two pastures or, if practical, livestock may be moved frequently among several pastures.

Continuous grazing reduces forage production and eliminates wildlife cover and food. Cattle trampling also destroys wildlife nests. Under certain management objectives and pasture conditions, continuous heavy grazing may be used as part of an overall program to improve grazing distribution.

Rotational grazing allows you to pasture more cattle together and also allows wildlife to use the rested pastures and areas adjacent to the fenced pasture. Rotational grazing permits the use of forages when they are at peak production, protein content, and palatability. It also helps the growth of legumes, such as clovers, and allows wildlife nests to survive, if the rest period is not too short. Rotating between pastures with native warm-season forages and those with cool-season forages increases productivity but requires careful management.

A grazing system will work well only if the grass or forage is adequate to support the livestock numbers, so keep stocking rates in mind. If your main objective is to produce the maximum amount of forage from your grasslands, you may want to investigate the use of a management-intensive grazing program. Here, the livestock is rotated among smaller paddocks at short intervals.

Both haying and grazing will remove nutrients from the soil. Fertilizer and agricultural limestone should be added to a pasture or hay land, but only after the soil is tested. For assistance with pasture management, rotational grazing, or soil testing and interpretation, contact your local USDA Service Center.

NCWRC

Diverse native grasslands provide forage and wildlife habitat.

Native Grasses

Many landowners are rediscovering the forage value of our native warm-season grasses. In addition to providing superior forage during the summer, these grasses, such as native bluestems, switch grass, Eastern gamma grass, and Indiangrass, also are good for wildlife. The growth pattern of these grasses is compatible with legumes and other broad-leaf plants that are important to both wildlife and livestock.

DON HAYES/NCWRC

Well-managed native grass pastures provide wildlife with overhead cover and ample travel lanes between individual plants.

Managed native grasslands provide better habitat for many bird and wildlife species than introduced grasses. They are taller (one to six feet), and individual plants form clumps providing travel lanes and escape cover, bare ground for feeding, and room for other plants to grow between clumps.

When the soil reaches about 60 degrees in the spring, the warm-season grasses begin growing. They grow best during the warmest months of the year when the soil is about 90 degrees. Although warm-season grasses have a short growing season, they make more efficient use of water and soil nutrients (nitrogen, phosphorus and potassium) than do other grasses.

Native warm-season grasses should not be grazed or cut closer than eight inches because, unlike low-growing exotic grasses, native grass has little leaf surface near the ground and, if cut or grazed too low, it cannot respond with rapid regrowth. Regrowth should not be grazed or hayed after mid-July. Late summer grazing and haying will reduce the vigor of the plants, weaken the stand, and eliminate important winter cover and spring nesting cover. Legumes may be overseeded on new warm-season grass plantings during the second year, after the grasses have become established.

While studies have shown that native warm-season grasses are efficient at removing nutrients from the soil, they do use large amounts of phosphorus (P) and potash (K). Studies also have shown that yields, crude protein, estimated net energy, digestibility, and relative feeding values were increased in big-bluestem/Indian-grass hay when the grasses were fertilized with nitrogen. The major increases occurred at rates of 50-100 pounds of nitrogen per acre with 50 pounds per acre giving the greatest return on the dollar. Nitrogen should be applied only in combination with prescribed burning to avoid problems with cool-season grasses and weeds.

Burning is an important management practice for native grasses. Fire releases nutrients, controls ground litter and some unwanted plants, stimulates seed production, and helps improve plant diversity within the grassland. This process helps distribute grazing pressure and benefits wildlife. Native grass stands should be burned in early spring as new growth begins to emerge.

Early travelers recorded that grass-dominated savannas and prairies were once common in North Carolina. These grasslands were dominated by warm-season grasses and supported several hundred species of plants. Today, most have been replaced by woodland, cropland or introduced grasses. The remaining remnants are referred to as pine savannas, piedmont prairies, oak glades, cane thickets, or mountain balds and are vital to the survival of many rare plants and animals and other grassland wildlife.

Historically, many of these grasslands were sustained by fire. If you are fortunate enough to have remnant native grasslands on your property, you have an opportunity to protect a resource that is valuable for conservation of grassland wildlife and plant diversity. Grassland remnants should not be fertilized or limed because the fertilizer may be used by undesirable weedy plants. Though no longer extensive in North Carolina, native grasslands, prairie remnants, cane thickets, and savannas provide high-quality habitat for many species of grassland-dependent wildlife.

Studies show that native grasslands that are prescribed burned in March and early April will contain more forbs (broad-leaf plants), while late April or May burns will favor the production of grasses. The timing of burning should be varied to maintain plant diversity. For assistance in identifying and managing native grasslands, contact the North Carolina Wildlife Resources Commission Division of Wildlife Management or your local USDA Service Center. See *A Landowner's Guide to Native Warm-Season Grasses in the Mid-South* (University of Tennessee Extension).

Grassland Wildlife Management Tips

- Rotating cattle through different pastures can improve cattle weight gains and wildlife habitat.
- Use both native warm-season and cool-season grasses in a rotation-grazing system.
- Avoid hayfields and pastures with only a single species of grass.
- Protect shrubby vegetation in drainages and along field edges with permanent fences.
- Adding a legume to perennial grass pastures and hay lands builds the soil, improves forage for livestock and wildlife, and supports abundant insects on which wildlife feed.
- Warm-season grass regrowth should not be grazed or hayed after mid-July.
- Establish fire lines around all warm-season grass stands and use fire to manage them.
- Consult an experienced land manager for details concerning the management of remnant native grasslands.

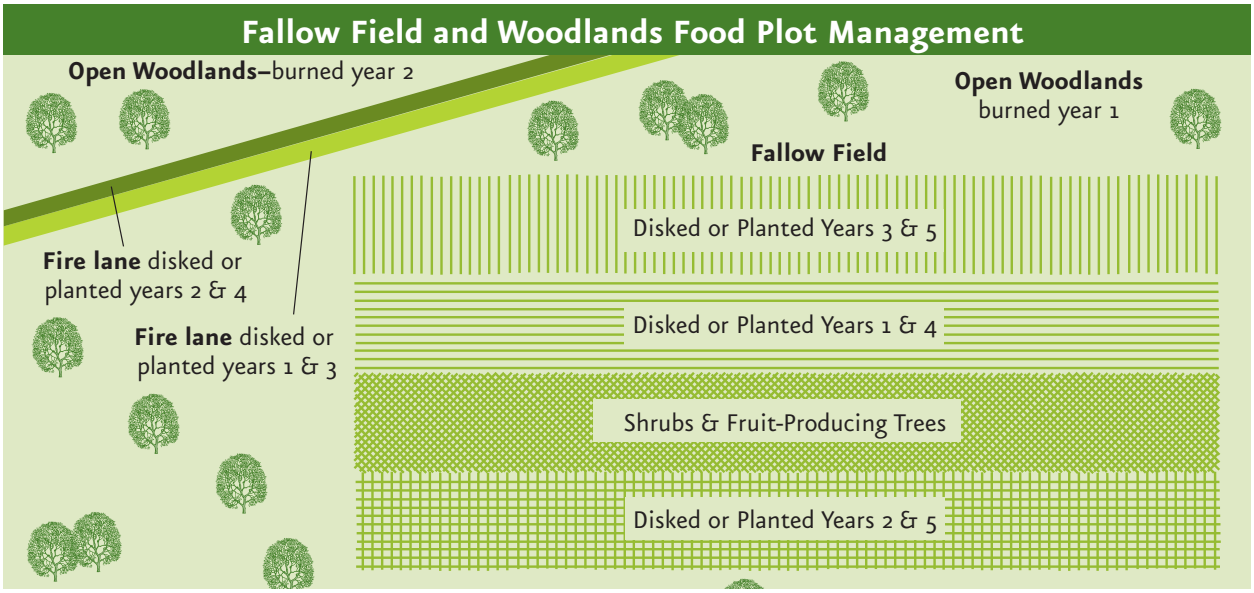
6 Idle-Area Management

Nearly every tract has some land that is unsuitable for or not needed for cultivation, forage production, growing trees, or landscaping. These idle areas and openings such as old fields, abandoned house sites, pond edges, utility rights of way or roadsides, logging decks, stream banks or corridors, brushy draws, erosive areas, or even a portion of your lawn can be used to benefit wildlife. With management, these areas can provide wildlife food, sites for nesting and raising young, and protection from the elements and predators.

Old Fields and Woodland Openings

Abandoned pastures, crop fields, and woodland openings can provide excellent wildlife habitat. One common problem in managing these areas is the pressure we place upon ourselves to keep them looking neat and orderly. Interspersion of plant communities, which is beneficial to many species, is contrary to our desire to have habitat divided into orderly management units. These areas will naturally produce beneficial plants, such as broomsedge, goldenrod, wild aster, beggerlice, sunflowers, wild strawberry, ragweed, blackberry, sumac, wild plum, and persimmon. All of these plants provide wildlife with either food or cover. Many songbirds use clumps or islands of wild plum and blackberry for nesting; quail use them for escape cover; deer browse on the twigs; and a host of species eat the fruits. So, resist the temptation to over manage.

Many species of wildlife are dependent upon the earlier stages of plant succession. Examples are field sparrows, common yellowthroats, quail, woodcock, and rabbits. Soil disturbance is necessary to stop the "old field" from growing into woodland. Disking and fire will help start the process over again making the area more productive.



Visit *www.ncwildlife.org/tarheelwildlife* or see Appendix D for links and more information.

Old fields can be maintained in a productive condition by using some of the following techniques:

- If the area was formerly pastureland, there is a good chance that exotic, sod-forming grasses compromise its value to wildlife. If fescue, orchard grass, Bermuda grass, Bahia grass, or another grass forms a thick sod, use a herbicide to kill the grasses prior to disturbing the soil. Dense stands of sod-forming grass can inhibit the growth of other plants and produce little food or cover for wildlife. Moreover, the thatch and dense growth at ground level can inhibit travel and feeding of some species.

- Some bare ground is important. Studies show that most quail nests are located within a few feet of bare ground. The hen quail will move her chicks, immediately after hatching, to bare ground in search of grit and insects. Songbirds and small mammals will use the bare spots to dust or to loaf when vegetation is wet. During the fall, winter, or very early spring, disk strips through the field on the contour to expose 75 to 80 percent of the soil within the strip. Make strips 30 to 60 feet wide and allow weeds to grow. You may want to seed some of the strips at the rate of five pounds of Kobe or Korean lespedeza per acre.

- Burn a portion of the areas between the disked strips. Burning sets back the plant community and stimulates production of seeds and insects that are important to quail chicks and songbirds. Burn at three- to four-year intervals and at different times of the year. Burning the ground litter also aids in quail chick movement and exposes seeds.

- A good rule of thumb is to disk or burn about one-third of the old field each year. Mowing is not preferred because it does not set back plant growth as much as disking or burning and it leaves a mulch of vegetation that smothers germinating seeds and buries potential food resources. Burning and disking can be used to prevent the area from reverting to forest. If a portion of the area is in danger of being reclaimed by forest, consider using a hot burn or herbicides to knock back vegetation to a manageable stage.

Timing is Important

Conducting management activities at the right time is important; for example:

- Burning during December leaves an area bare of cover for months. Burning just prior to or during spring green-up minimizes the time that an area is deficient of cover.

- Disking in the fall, winter, or early spring usually stimulates production of annual weeds that provide large seeds and great habitat for young wildlife. Disking during the summer often produces dense stands of undesirable plants such as crabgrass or sicklepod.

- Disking a weed patch to plant a food plot in June may destroy nests and young. This can be prevented by planning ahead and disking areas scheduled for summer plantings prior to nesting season.

Leave clumps of shrub or briar growth of about one-tenth acre each at 50- to 100-yard intervals to provide wildlife cover. These cover areas can be more easily managed if composed of vines (grape, greenbriar, or trumpet creeper), shrubs (alders, elderberry, blueberry, blackberry, hawthorns, or plum), and small trees (dogwood, serviceberry, sassafras, or persimmon) rather than fast-growing trees species such as pine, maple, poplar, or sweetgum.

Construct brush piles about one-tenth acre in size to augment natural cover. Discarded Christmas trees and limbs from tree trimming make ideal brush piles. Loosely constructed brush piles will develop into tangles of blackberries and vines. Where practical, protect these from burning.

Hinge cut small trees located in idle areas by cutting two-thirds of the way through the trunk and bending the tree parallel to the ground. Many trees will continue to live in this position, creating a living brush pile.

Plant a portion of the area to a green browse plot, a grain food plot, or, if cover is sparse, plant native warm-season grass strips. But keep in mind wildlife habitat requirements and resist the temptation to over manage your old field, former pasture, or opening.

Landscaping for Wildlife

Many of the techniques discussed in this booklet can be applied in the front or backyard. Creating zones of progressively taller wildflowers and native grasses, and transitioning to shrubs and small trees between small lawns and wooded areas can be an attractive way to provide cover. Many native fruit-producing shrubs and small trees are suitable for planting in "islands" to break up extensive areas of lawn. Other techniques such as brush piles or half cutting are more suitable for back corners and hidden nooks. Actions that replace monocultures of grass (lawn) with more diverse plants are a step in the right direction to benefit wildlife.

CHRIS MOORMAN/NCSU

Replacing lawn areas with diverse plantings of native species will benefit wildlife.

Landscaping your home site with native wildflowers and shrubs will make it attractive to many species of butterflies and songbirds. Hummingbirds are particularly attracted to red or orange tubular flowers such as trumpet creeper, honeysuckle, cardinal flower, columbine, bergamot, and red buckeye. Other songbirds will use fruits and seeds of shrubs such as viburnum, American beautyberry, silky dogwood, and spicebush. Butterflies are attracted to native flowers such as milkweeds, coneflowers, phlox, mints, blazing stars, and asters.

Choices must be made in the backyard just as they are made in managing larger properties. Do you want to focus on providing habitat for species that prefer taller trees and a shady understory or species that thrive in sunny landscapes? Preventing disturbance and wildlife mortality from dogs and cats, planning food and cover sources in close proximity, and managing against nest competitors like brown-headed cowbirds should be considered when planning your landscape. More detailed information concerning landscaping for wildlife is available from your local *NC Cooperative Extension Service* office or from *Going Native Urban: Landscaping for Wildlife with Native Plants* (N.C. State University).

Old Home Places

The shrubs, lawn grasses, fruit trees and weeds found around old home places can provide an oasis for wildlife. The abandoned house site usually has a mix of weeds, overgrown shrubs, and mast trees that provide food and cover resources valuable to many species of wildlife. The stately old trees, with their many cavities and high production of nuts, fruits, and seeds, are attractive to squirrels, deer, and songbirds. Old concrete and rock foundations attract groundhogs, whose burrows provide homes and cover for rabbits, raccoons, and red foxes. Grasses, flowers, and shrubs are eaten by deer and rabbits. Grasshoppers and other insects, which are critical foods for quail and turkey broods, are attracted to this lush vegetation.

Old home places can be improved by practices such as half cutting, constructing brush piles, and strip-disking in openings. Fruit-bearing shrubs and trees such as walnuts, persimmon, cherry, hawthorn, and wild plum can be released from competition. Disk strips around and through the lot to stimulate new growth of grasses and legumes. Disking from fall through early spring is best.

Uplands Adjacent to Ponds

You should develop the area around your pond according to what you and your family enjoy. A pond site can be developed for wildlife habitat, fishing, or other types of recreation.

Trees and shrubs may be planted around the pond for cover. Windbreaks help reduce wave erosion and provide food and nesting areas for wildlife. To avoid damage to the dam by root penetration, do not allow trees to grow on the dam. Trees should be planted far enough from the shore so that they do not interfere with fishing. All ponds are used at times by wildlife. By developing good cover around the pond, a landowner can increase this usage.

If the watershed is grazed, fencing off an area around the pond that is one to one and a half times the water acreage permits the development of ideal wildlife cover but may limit access for bank fishing. The larger the cover area, the more attractive it will be to wildlife.

Stream Banks and Riparian Corridors

Adjacent aquatic habitats, fertile soils, and the unique variety of trees, shrubs and other plants that grow along streams make riparian zones especially important to wildlife. Many wildlife species depend on riparian areas for all or part of their habitat needs. Some wildlife species are restricted to plant communities bordering streams and spend their entire lives within this zone. Examples of birds that live primarily along streams and in riparian zones are American woodcock, Swainson's warbler, Louisiana waterthrush, Northern Parula, and Acadian flycatchers.

JEFF MARCUS/NCWRC

Many species depend on riparian corridors for all or part of their habitat needs.

More often than planting, improving habitat along riparian corridors entails managing plant succession. With proper management, corridor plant communities can be developed to benefit species with diverse habitat requirements. Corridors managed to encourage early-successional shrub and understory plant communities by selectively controlling trees can benefit declining bird species such as American woodcock, Swainson's warblers, common yellowthroats, or even quail. Corridors managed to provide habitat for Eastern wild turkeys, migrating warblers, and woodpeckers should be allowed to mature and be protected from extensive timber harvest. These areas can be managed for mature mast producers, dead and down woody debris, snags, and den trees. In urban areas or intensively-farmed landscapes, a strip of riparian woodland may be the only woody cover to be found.

Utility Rights of Way and Access Roads

Rights of way and access road shoulders can provide excellent habitat for early-successional wildlife. Often rights of way support remnant native grasslands and diverse plant communities. The wildlife management goal for rights of way should be to provide a diverse groundcover or locations for food plots, if managing primarily for deer and turkeys. Areas outside of safety zones, along highways can be managed to provide wildlife habitat while accomplishing the primary purpose of keeping the site from reverting to woodlands. Rights of way can be enhanced by feathering woodland edges (page 15), managing as directed for old fields (page 34), spot-spraying trees, or burning.

Another consideration when managing rights of way and access roads is to gate, block, or screen them where they intersect with public roads to prevent trespass and reduce disturbance. Keep in mind the primary purpose of the opening and coordinate with right of way managers to prevent management conflicts.

Brushy Draws

Brushy draws that extend into crop or hay fields can provide quality habitat for early-successional wildlife and help control soil erosion. A brushy draw should contain vines, brush, and grasses but only an occasional large tree.

Livestock should be excluded from these draws. Cattle can quickly destroy the low-growing shrubs important to wildlife as sources of food and cover. Brush piles can be constructed along the edges and at the head of the draws. To avoid clogging the drainage, don't place a brush pile in the bottom of the draw. Draws managed in a dense cover of vines, briars, and shrubs can provide excellent small game habitat. Use fire, mechanical methods, and spot-spraying of herbicides to control trees in brushy draws.

Erosive Areas

Access roads, logging decks, steep fields and pastures are subject to erosion. A careful evaluation to identify the cause of the problem should be the first step. Sometimes the land will require reshaping to change flow patterns of runoff before the site can be stabilized. After redirecting water flows or reshaping the area, prepare the site by disturbing the soil and adding nutrients. Follow this by planting an annual grain and mulch to hold the site until volunteer vegetation becomes established. Avoid planting aggressive exotic perennial grasses and legumes. Because each site is unique, request assistance from your nearest USDA Service Center to develop a plan to rehabilitate problem sites.

Hedgerows

A brushy hedgerow or fence line can provide an important connecting link between different habitat types on the farm. The simplest way to develop a wildlife travel lane is to stop mowing, grazing, or cultivating the strip next to the fence. On grazed areas, install a double fence to protect a wildlife travel lane. An electric fence is effective and inexpensive for this purpose, but it must be maintained in good repair. Hedgerows are most effective when developed adjacent to field borders or fallow areas.

If some of the larger trees in a hedgerow or fencerow are cut for firewood, the tops can be used to make brush piles. If the area planned for hedgerow development has a grass sod, spraying and disking will reduce grass competition and create a seedbed where seeds of shrubs and vines (such as redbud, blackberry, grape, sumac, hazelnut, wild plum, and greenbrier) and trees (such as persimmon, red mulberry, cherry, and dogwood) can volunteer or be planted. To speed the process, loosely pile tree tops and brush in the area planned for expansion. Birds perching in the brush will plant a diversity of shrub and tree seeds. If you are impatient, plant wild plum, grape, and blackberries to improve the cover. Seedlings should be mulched to conserve moisture and reduce grass competition.

Idle-Area Wildlife Management Tips

- Disk strips in old fields to set back plant succession.
- Hinge-cut cedars and cull trees, such as locust and elm, for quick cover.
- Fence out livestock from pond banks, stream banks, brushy draws, springs, and seeps.
- Manage fencerows for cover and travel lanes.
- Use herbicides to kill exotic grasses and allow seed-producing weeds and legumes to grow.
- Burn native grass and weedy areas at different times and intervals to create plant diversity.
- Use approved herbicides to control invasive plants, release desirable tree species, create snags, or release shrub communities.
- Feather edges to create wide transition zones where rights of way border woodlands.
- Gate access roads and screen rights of way and openings to reduce disturbance.

7 Wetland Management

A wetland is an area of land containing high soil moisture during at least part of the year and supporting water-tolerant vegetation. Wetlands come in many shapes and sizes and include wooded swamps, flowing brooks, salt marshes, beaver ponds, or *pocosins*.

Wetlands serve an important function as biological filters that remove sediments and pollutants from surface waters. They also act as natural sponges reducing flood severity by slowly discharging excess water back into streams or the groundwater table. Wetlands are biologically rich and often contain a greater diversity of plants and animals than is found in drier habitats. They are excellent habitat for many kinds of waterfowl, shorebirds, and songbirds and are important as amphibian- and fish-spawning and rearing areas.

Historically, natural wetlands dominated floodplains and river deltas, and most level or nearly level lands in the Coastal Plain were wetlands. From the time development of our state began, wetlands have been drained for agriculture, forestry, and flood control. We now realize how important it is to conserve our few remaining natural wetlands, restore those that have been drained, and develop new wetlands wherever possible.

Many of today's wetlands were developed by human engineering. That is, they were constructed on previously dry or seasonally flooded land and are maintained by levees and water-control devices. Construction and development of private wetlands should be approached cautiously and only after consulting with regulatory agencies and experienced engineers. NCWRC Division of Wildlife Management biologists can assist with initial site inspections.

Most wetland management today is directed toward creating and improving waterfowl habitat. In this type of management, production of food for waterfowl is a primary concern.

Diverse groups of important food plants grow naturally on moist or wet soil. These soil conditions also provide excellent growing conditions for invertebrates, such as small snails, clams and insects, which are good waterfowl foods. Wetland-management techniques can encourage the growth of these moist-soil plants, or domestic grains can be planted and then flooded for supplemental food.

Flooded Fields and Cropland

On developed wetlands, moist-soil plants are encouraged by drawing the water from the fields during the growing season. This allows germination of the seeds that are present or for seeds to be planted. The timing and rate of the drawdown are important for good plant growth. Although there is no set method for determining the best time to draw down a wetland, a general recommendation is that the water be held on the wetland until early summer (May-June), if managing for native plants, and removed earlier, if agricultural

JOE FULLER/NCWRC

Waterfowl impoundments will be more productive when located in close proximity to other wetlands that offer alternate feeding and resting sites.

crops are planted. If managing for natural revegetation, the rate of the drawdown should be slow enough to prevent rapid drying of the soil. This will discourage undesirable species while stimulating desirable moist-soil plants. The wetland is then reflooded to make these foods available for waterfowl. A slow, progressive reflooding is best starting around the first of September for migrating teal or the first of October for many other waterfowl species.

Flooded grain crops can be beneficial for waterfowl, especially late in the winter when the weather is extremely cold. Corn or grain sorghum should be flooded from Oct. 15-March 30. Crops planted specifically for waterfowl need not be clean-tilled because the weeds will provide additional food. Japanese millet also can be sown (15 pounds per acre) to supplement the cultivated crops.

Impoundments constructed near waterfowl resting areas will be most productive for waterfowl management. Study potential water sources for flooding your impoundment because pumping can be expensive and surface sources may not be dependable.

Flooded Timber

Bottomland forests are an important wetland habitat type. A low dike can sometimes be constructed to seasonally flood bottomland hardwoods. The management plan for a bottomland forest should protect the health of the trees; therefore, no flooding should occur during the growing season. Flooding dates, depths, and duration should vary from year to year to maintain the productivity of the forest. A forested wetland usually can be flooded from mid-October to late-February. The water should be drained before the trees leaf out. A slow drawdown is better than a rapid one because more preferred plants will be produced. Open areas in the forest can be planted in Japanese millet or managed for natural foods.

Temporary Pools

Because of our diverse landscape, geologic history, and climate, North Carolina supports a tremendous diversity of amphibians. Temporary or ephemeral pools are important breeding sites for frogs and salamanders. These pools may also be used by reptiles, migrating shorebirds, waterfowl, and songbirds. Ephemeral wetlands are important to many amphibians because they do not support fish populations. Fish prey upon eggs, young, and adult amphibians and compete with them for food. Some of the species that use these areas are upland chorus frogs; spring peepers; southern leopard frogs; narrow-mouthed toads; eastern spadefoot toads; and spotted, mole, and marbled salamanders.

JEFF MARCUS/NCWRC

Temporary pools are important breeding sites for frogs and salamanders.

The first consideration should be to recognize and protect existing ephemeral wetlands. These wetlands can be located by sight during wet periods or, frequently, they are found by listening for a congregation of breeding frogs. If you have a temporary wetland on your property, protect it from drainage and maintain a buffer of upland habitat around the site since most of the amphibians that breed there spend a good portion of their life cycle in adjacent uplands.

Successfully constructing a temporary wetland is not an exact science. But if you wish to give it a shot, first do some research to determine the year-round habitat needs of the amphibian species that occur in your area. Next, study the landscape to locate an appropriate site. Look for old ditches, natural low spots, or dips in the landscape. These sites can occur almost anywhere on flood plains, uplands, forests, fields, or pastures. Areas on flood plains are especially attractive because they fill up during floods. If the site holds water for two or three months, there is a good chance it is already being used by breeding amphibians and shouldn't be disturbed.

If the soil type on the site will hold water, a small pool can be constructed in less than a day using a small bulldozer or a tractor and blade. A depth of one to two feet is ideal, and the pool should have gently sloping sides. Pools can be of

almost any size or shape depending on the site. Once the pool is constructed, there is usually no need to introduce aquatic plants or animals. The soil in a seasonally wet area will frequently have a seed bank of wetland plants, and animals are good at finding wetlands on their own. If plants are introduced, care should be taken not to use aggressive species such as cattails.

If constructed correctly, your pool will dry up during the hottest part of the summer and fill up again in the fall or spring just in time for the next breeding season. Soils with good clay content are easier to work with and usually hold water better than loamy or sandy soils.

Care should be taken to avoid jurisdictional wetlands (wetlands protected under the Clean Water Act and requiring a permit prior to disturbance) and sites likely to be exposed to excessive flooding. Flooding can flush the pond's amphibians into adjacent streams and allow the introduction of unwanted fish. Many cattle water holes that failed to hold water year round have turned out to be productive ephemeral ponds for amphibians.

Small Ponds

Most farm ponds are managed for fishing with the goal of maintaining water level year-round. However, if aquatic weeds are a problem, landowners can use winter draw-downs of one to three feet to discourage aquatic weeds.

When managing a small pond for waterfowl and wildlife takes priority over fishing, it should be drawn down one to two feet in early June to encourage beneficial plants, then allowed to refill with rainfall and runoff in the fall. Mudflats around ponds can be seeded to Japanese millet, but most moist sites will grow native plants that produce good wildlife foods.

If water control is possible, sloughs can be managed as described above.

Beaver Ponds

Beavers are a *keystone wildlife species*. The habitat that they create is important to many other species of fish and wildlife. Beaver ponds often require little management. However, on small streams, habitat for waterfowl can be enhanced by lowering water levels one to two feet during the growing season and planting foods or allowing natural foods to develop. For information on controlling water levels and managing problem beavers, see *Beaver Management in North Carolina* (North Carolina Wildlife Resources Commission).

STEVE MASLOWSKI

Wetlands created and maintained by beavers provide habitats for a variety of wildlife.

Springs, Seeps and Bogs

Springs, seeps and bogs (bogs are upland marshes dominated by sedge, grass and shrub communities) are not common, but can be found scattered throughout the state. These habitats are valuable watering areas for wildlife, as well as home to many rare wildlife species and plants. Bogs in western North Carolina are critical habitat for the endangered bog turtle. Livestock should be excluded from springs and seeps, but managed grazing is sometimes used as a tool to set back succession in mountain bogs.

Wetland Restoration

Restoring water to previously drained wetlands is beneficial to many species of wildlife. Drained wetlands may have surface drainage (ditches) or internal drainage (drain tiles). Considerable planning and expertise is normally required to obtain the desired results and to avoid legal aspects of placing fill in wetlands. Before attempting wetland-restoration projects, consult your local office of the Natural Resources Conservation Service located in the USDA Service Center for technical assistance and to determine if technical or financial assistance is available.

STEVE MASLOWSKI

Beaver ponds provide high-quality habitat for wood ducks.

Wetland Wildlife Management Tips

- If the site holds water for a month or more during most years, protect it and adjacent uplands.
- Fence stream banks to exclude livestock.
- Study the landscape and soils to locate a suitable site for impoundment or pool construction.
- Place nesting structures for wood ducks in ponds and wetlands.
- Learn the habitat needs of amphibians that live in your area.

8 Species Management

Following are thoughts on managing some popular wildlife species favored by North Carolina landowners. These are species most commonly managed by our state's citizens, but management for these species should not be viewed as a negative for other wildlife. For example, quail management benefits numerous declining songbirds and even lesser-known species of butterflies and beneficial insects.

We are fortunate today that information about the life history and habitat requirements of many species is available online, in publications, and from wildlife researchers and managers. By doing some research and seeking professional assistance, you should be able to tailor your land-management efforts to benefit the species or group of wildlife that interests you. However, just remember that as in managing the species below, you will be limited by the capability of your land and the landscape in which your property is located.

Northern Bobwhite Quail

MELISSA MCGAW/NCWRC

Food

Quail use more than 1,000 species of plant foods. They feed on the seed of ragweed, lespedezas, beggars' lice, trumpet creeper, acorns, pine seeds, and many more species. Fruits are especially important during summer, but are used at other times when available. Fruits used include blackberries, blueberries, honeysuckle, sassafras, and dogwood. During late winter and early spring, greens and succulent plant materials are especially important. Insects are essential foods for nesting hens and fast-growing young. Important insect foods include grasshoppers, crickets, beetles, ants, and true bugs.

Cover

Ideal quail habitat is composed of extensive areas of broomsedge and other native grasses, ragweed, goldenrod, farm crops, open woodlands and other low-growing weeds and wildflowers. These plants should be interspersed with escape cover consisting of clumps of woody cover, such as plum thickets, briar tangles, shrub, severed tree tops, and hedgerows.

Reproduction

Females lay multiple clutches of eggs. During one summer, researchers documented that a radio-marked North Carolina hen (on Fort Bragg Military Reservation) laid three nests of eggs; two of which were incubated by males.

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Quail are ground nesters with a nesting season that starts in May and extends until October. Quail lay 12 to 15 eggs in the first nest of summer with a 23-day incubation period. Young leave the nest within 24 hours of hatching, are brooded by an adult, but feed on their own.

Home Range and Survival

Home range size varies from 40 to 200 acres. Home ranges are smaller in better quality habitat. 25 to 30 percent of quail disperse from winter ranges to breeding habitat. Average dispersal distance is a little over a mile. Seventy to 80 percent of birds live less than one year.

Though populations have steadily declined over much of the species range in recent years, quail still occur where grassland, farmland, and brushland provide a favorable mix of habitat types. Populations respond most favorably to management in landscapes with a high percentage of early-successional habitats. Examples where you would expect quail management to be most effective include areas where the majority of the land is in cropland, grasslands, young forest regeneration, or open-canopy forests with a groundcover of grasses and forbs. In landscapes where row-crop farming is a predominant land use, quail will respond positively when relatively small amounts of habitat are provided. However, small areas devoted to habitat improvements in landscapes dominated by forest often do not make noticeable differences in populations.

Habitat management for quail works—but only when it is done at the appropriate scale and is directed toward increasing the amount of useable habitat available to birds. Energy expended in developing islands of habitat in landscapes that are otherwise unusable by quail are rarely productive. Quail habitat consists of native grasses, which provide nesting sites and cover; forb-dominated areas, which provide brood habitat and produce seed foods; and dense woody escape cover. All three habitat types must be in close proximity.

The major land uses in an area will determine what habitat-management techniques are most suitable. Developing borders of volunteer vegetation and woody escape cover on field edges and ditch banks are effective techniques on landscapes where row crop agriculture predominates. Planting native grasses, developing woody cover on fencerows and edges, and burning are techniques that work well on grasslands. Thinning to a basal area of 40 square feet per acre and burning on a one- to two-year rotation in blocks from 10 to 50 acres in size are techniques to provide high-quality habitat in forests.

Managing Cover for Quail

Without disturbance, quail habitat doesn't last long. Brushy field edges or young forest plantations grow into sapling stands that shade and smother groundcover and leave quail exposed to predators. Weedy fields develop a thatch at ground level, and food plants don't persist without frequent disturbance. Open woodlands quickly turn into tree-choked areas with litter-covered ground. Because of our fertile soils and abundant rainfall, repeated treatments at one- to five-year intervals are required to maintain habitat in a suitable stage of plant growth.

Techniques for developing and managing cover for quail include burning, disking fallow areas, planting annual and perennial crops, and cutting or killing trees and brush that have grown too tall. The goal for each of these techniques is to encourage a plant community that provides secure screening cover and a variety of low-growing grasses and forbs.

One additional practice worth discussing is the creation of woody escape cover. This habitat type is often limiting and should be considered whether managing woodlands, croplands, or grasslands. Consider an area to be suitable escape cover if you can't walk through it. Creating and maintaining this escape cover is an ongoing process. Ideally, clumps of woody escape cover ranging in size from one-tenth acre to one acre should be located no more than 100 yards apart. Escape cover can consist of impenetrable areas of blackberry or plum thickets, cane and greenbrier-dominated drains, or loosely piled woody treetops and brush. Edge feathering is one way to provide escape

cover and is suitable for use on field edges, rights of way edges, hedgerows, and fence lines that have become open at ground level because of competition from trees. (See "Edge Feathering and Woody Cover Establishment," page 64).

Quail eat greens and insects during the spring, and insects and soft mast are used heavily during the summer. During the fall and winter, quail are primarily seed eaters. The winter quail diet varies across the state. In grain-producing areas, soybeans are the most important winter quail food, and many hunters plan their hunts based on locations of soybean fields. In other areas, quail rely heavily on tree or weed seeds but also use grain crop residues, when available.

It is essential that food be available close to escape cover. Quail should be able to walk through good cover to their feeding grounds and have several areas of woody escape cover within close proximity. See *Growing and Managing Successful Food Plots for Wildlife in the Mid-South* (University of Tennessee Extension) for planting instructions for quail food plots.

Good nesting cover is most often located in native grass stands that are not mowed, burned, or grazed during the previous winter. Nesting cover in blocks several acres in size or in borders 30 feet wide or wider is preferred over narrow strips of nesting cover that are easily hunted by predators. Quail roost on the ground in vegetation that is not too dense but still provides concealment from above. The roost is usually in open, "clumpy" vegetation away from thick or tangled escape cover. Fields of ragweed, broomsedge, or Indiangrass are good roosting areas.

Disking is used to change the composition of plants within the quail range. The removal of strips of sod-forming grasses, such as Bermuda and fescue, will make room for the seed-producing plants that are important to quail. Disking can be applied to old fields where the vegetation has grown into a stagnated condition that provides less diversity of plants. However, if fescue or Bermuda are the major grass component, disking may only enhance the exotic grasses. In this situation, herbicide must be used to kill the sod-forming grass prior to initiating a disking regimen.

Fallow crop fields that have produced tall weeds for a couple of years can be made more accessible for quail broods by disking from November to April. The short, fast-growing vegetation that is generated after disking will produce insects that also are important for quail chicks. Disking strips in alternate years will add to the field's diversity and prolong its usefulness for quail and other wildlife that use this habitat component. Results from disking vary depending upon the agricultural history of the area. In areas with a long history of row crop farming and herbicide use, quail foods such as partridge pea, annual lespedezas, beggar's lice, and ragweed may not volunteer. In these situations, a one-time seeding may be required.

The most economical, useful tool for anyone wanting to increase wild quail is prescribed burning in open-canopy woodlands, old fields, native grass plantings, ditch banks, and field borders. The removal of litter makes quail food easier to find. Important plant seeds scarified by the heat will germinate much better on the burned-over range, while young sprouts and flowering and fruiting plants support insects in spring and summer. Furthermore, burning releases the nutrients tied up in vegetation and stimulates the building of nitrogen in the soil.

Timing of burns and burn block size are important considerations. Burns during March and April are most appropriate because cover returns quickly and nesting activities have not been initiated. However, under some circumstances, burns during the growing season are justified to control hardwood sprouts. Burn blocks of from five to 50 acres can be scattered across a property to provide food and cover in close proximity.

See Appendix C for information on monitoring quail.

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Common Quail Habitat Management Mistakes

- *Incorrectly identifying woody cover*—Woody escape cover must be dense at ground level but not necessarily tall. Once the cover near the ground opens up to the point that cover from knee-height down is shaded out and accessible to predators, it is no longer of value to quail.
- *Carrying too many trees*—Forests managed for quail must be thin enough that they support a continuous cover of low-growing grasses and forbs. On most Coastal Plain soils, thinning to *basal areas* below 50 will be required to provide adequate groundcover to support quail.

Points to Ponder

MANAGEMENT—Target management to convert non-habitat (closed-canopy woodlands, mowed areas, overgrazed pastureland, and large row crop fields) into useable habitat.

BIGGER IS BETTER—Highest quail densities are reached where open habitats that support native grass and forb-plant communities dominate a large percentage of the landscape. Quail increases have been consistently documented where field borders were established in open row crop farming landscapes. However, habitat created in forest or introduced grass-dominated landscapes often does not become occupied by quail. To sustain a high-density quail population in otherwise unsuitable landscapes, such as forest or introduced grass, habitat must be well dispersed across 5,000 to 10,000 acres of land.

IT'S ALL ABOUT GROUNDCOVER—Diverse, low-growing plant communities provide cover, food and nest sites.

MINIMIZE POPULATION SINKS—Plant communities that have opened up at ground level to allow access to predators should be set back to an earlier stage of plant growth. Examples include overgrown hedgerows, clumps of hardwoods, and closed-canopy forest.

NEW GROUND EFFECT—Habitat improvements that occur on a large scale elicit population responses. Best population responses are obtained when habitat disturbances such as timber harvest, land clearing creating windrows, or installing field borders occur in a short period of time across a large area.

PREDATORS AND QUAIL—"Well distributed bits of bushy refuges not more than 100 yards apart over both open woodlands and fields are by far the best protection one can provide for the quail; then the cooper's hawks go hungry in a land of plenty, for the quail can easily elude them." (Stoddard, 1961)

Eastern Cottontail Rabbit

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Food

Rabbits browse a variety of plant leaves, buds, and stems during the growing season. During winter, they feed on bark, dried stems, and plants such as clovers, small grain, or weeds and grasses that remain green.

Cover

Highest densities occur in extensive areas dominated by briar tangles, shrubby areas, and young forest stands.

Native grasses and low-growing weeds and wildflowers that provide dense protective cover, both overhead cover and horizontal cover, often support high rabbit populations.

Reproduction

Young are born from March to September. Females give birth to three to eight young with an average of four young per litter. Young rabbits are independent in 18 to 21 days. One pair of rabbits has the potential to increase to 25 individuals over the long reproductive season.

Home Range and Survival

Home range is usually about 10 acres. On average, rabbits survive less than one year.

North Carolina has three species of rabbits: Eastern cottontail, Appalachian cottontail, and marsh rabbit. The Eastern cottontail occurs statewide. The marsh rabbit is found in wetlands on the Coastal Plain and the eastern fringe of the Piedmont. The range of the Appalachian cottontail is restricted to higher elevations in the mountains of western North Carolina. Management activities directed toward improving rabbit populations are similar for each of the three species.

Rabbits are common statewide, but highest densities are achieved in extensive areas of uniform escape cover such as young pine plantations, abandoned farmland, or native grass fields. Rabbits thrive in impenetrable cover of at least one-quarter acre in size that has not been exploited by predators or where mammal predator densities are low (usually resulting from disease outbreaks such as distemper and rabies).

Rabbits have small home ranges and are incredibly productive. Unlike quail, they can be successfully managed on a few acres of land. To be successful, the rabbit manager must focus on increasing survival. Rabbit predators include snakes, house cats, dogs, raptors, foxes, bobcats, crows, and coyotes. Controlling populations of the many predators is beyond the means of most managers. Fortunately, manipulating habitat to manage predation is a productive alternative to reduce losses to predators.

Habitat management for rabbits should focus on maximizing screening cover at ground level, providing dense escape cover to discourage mammalian predators, and providing overhead screening with a minimum of perch sites to protect rabbits from aerial predators. Many of the techniques discussed earlier under grasslands, croplands, and idle-area management will provide excellent rabbit habitat. Some other specific techniques are discussed below.

Brush piles bring the quickest response of all management tools. Rabbits often take over a brush pile the night after construction. Cutting lone trees and snags that serve as raptor perches will discourage predation from above and provide materials to develop a brush pile. Place brush piles close to other cover such as briars, native grasses, fencerows, or

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dense young woodlands. Don't burn brush piles left from clearing; instead, windrow them in the center of the field for cover. (See Edge Feathering and Woody Cover Establishment on page 64.)

Create or encourage impenetrable islands of woody or briar cover surrounded by native grasses. This can be accomplished when clearing land by loosely piling brush or identifying areas of blackberry or greenbrier and planting native grasses adjacent to them. Windrows should be considered temporary as they melt away after a few years. Piling brush is an inexpensive way to develop briar, vine and shrub cover. Birds perching on the brush pile will deposit seeds of many desirable cover plants.

Stands of tall-growing native warm-season grasses typically support good rabbit populations. Switchgrass or Atlantic coastal panic grass are good choices, if managing specifically for rabbits, because they provide more dense overhead cover. Properly managed native warm-season grass pastures and hay fields can provide excellent rabbit habitat. Adjacent fencerows should be protected from grazing, and the larger trees along fencerows should be killed and felled. The resulting dense growth will provide good rabbit cover.

Converting areas currently growing fescue, Bahia grass, or Bermuda grass to rabbit habitat requires the use of herbicides. (See the herbicide discussion on page 65.) Likewise, herbicides can be used to create or maintain habitat where trees are shading low-growing cover. Herbicides with the active ingredient imazapic will selectively remove many species of hardwoods and encourage blackberry.

Planting rabbit foods should be considered secondary to providing cover. For suggestions on food plots for rabbits, see discussion of rabbits under Food Plots, page 63, and *Growing and Managing Successful Food Plots for Wildlife in the Mid-South* (University of Tennessee Extension).

We can do too good of a job with habitat management. Extensive areas of great rabbit habitat make it difficult for hunters to harvest rabbits, so cutting shooting lanes just prior to hunting can facilitate harvest by hunters. However, remember that the lanes will allow more loss to predators.

Gray Squirrel

Food

Squirrels feed on pine seeds, acorns, hickory nuts, beech nuts, berries and fruits, buds, fungi, and some insects.

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Cover

Squirrels take refuge in large trees. Dens and nests are located in hollow trees and in nests constructed of leaves.

Reproduction

Two peaks of reproduction result in most litters being born from early February-April or during July-August. Litters average from two to four, and young are independent at 12 to 14 weeks.

Home Range and Survival

Gray squirrel home ranges average about four acres with those of males slightly larger than females. Average life expectancy is dependent upon mast abundance, and annual survival of young can range from a low of five percent, following a mast failure, to a high of around 30 percent when food is abundant.

The gray squirrel is the most common and widespread squirrel in North Carolina. However, we have Eastern fox squirrels on the Coastal Plain and in the southern Piedmont and midwestern fox squirrels in several northwestern mountain counties. Fox squirrels differ from gray squirrels in that they seem to prosper in more open forests

or woodlots where they spend considerable time on the ground and where food and cover resources are patchy in distribution. The tiny red squirrel or "boomer" occurs in the Mountains and northern Piedmont. They are most common in conifer forests where they gather and cache large quantities of cones. Two species of flying squirrels and chipmunks, which are not game species, also occur in the state.

The productivity of squirrel populations in a woodland is tied to the annual fluctuations of food resources and nest sites. Populations increase following years of abundant mast. Management consists of protecting mast-producing trees and den trees and providing an adequate number of cavities. Certain practices, such as installing den boxes, are appropriate in young forests where cavities are scarce and are promptly utilized. Others, such as releasing mast trees by cutting adjacent trees, require several years to take effect.

Hardwood and mixed pine-hardwood woodlands, containing trees such as oak, hickory, walnut, elm, maple, beech, dogwood, and mulberry, produce nuts, seeds, or fruits and make excellent squirrel habitat. Mature trees will increase the volume of food produced and the number of cavities available.

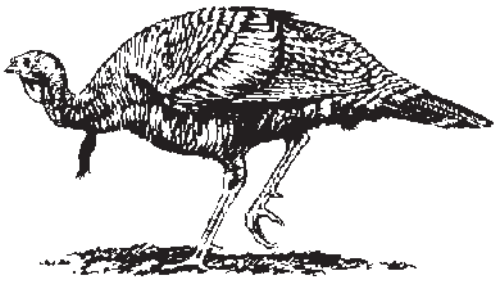
Conservative timber-stand improvement, or TSI, which reduces competition among trees, will increase the production of acorns and other squirrel foods. Timber harvest and heavy thinnings that space trees such that squirrels cannot travel through the treetops is detrimental to gray squirrels. Retaining a closed-canopy stand of hardwoods in streamside management zones can be an important long-term management tool.

A mature forest usually has more cavities for squirrels than younger woodlands. In woodlands with fewer than four natural dens per acre, artificial dens will be of value. Competition for dens among squirrels, owls, bees, snakes, and other cavity users is intense. When artificial dens are supplied, some of this competition is reduced. Dens can be built from auto tires, rough lumber, or hollow logs cut in sections. See *Homes for Wildlife II Plans* (Michigan Department of Natural Resources) for details on how to build and install a squirrel den box.

Eastern Wild Turkey

Food

Foods include acorns, ash, and beech seeds, berries and fruits, green leaves, tubers, flowers, insects, snails, and even small animals. Young turkeys eat mostly insects during the first few weeks of life.



Cover

Turkeys roost in trees and forage in open midstory forests, grasslands and cropfields where visibility is good. They use grassy or weedy areas, forest edges, and woodlands with herbaceous groundcover for brood habitat.

Reproduction

One male will breed with many females. Incubation and brooding is done exclusively by the hen. Turkeys nest on the ground in April-June. They average 10 to 12 eggs per clutch and incubation lasts for 26 to 28 days.

Young leave the nest within 24 hours of hatching, are brooded by the hen, but feed on their own. Young grow incredibly fast and can fly in about 14 days.

Home Range and Survival

Home ranges are variable in size but average several thousand acres. Average life expectancy is less than 2 years.

Wild turkeys range over large areas and use an extraordinary variety of plant and animal foods during the course of the year. They select habitats that are open enough for them to see potential predators and generally avoid dense young forest stands and areas where human disturbance is high. Key habitat types are mature pine and hardwood forests with mast-producing hardwoods, which are used year-round but are especially important in the fall and winter. Also, openings are used sporadically year-round but especially during the spring and summer.

Because turkeys use a variety of hard and soft mast seeds depending on their availability, it is important to maintain a variety of hardwood species including oaks, ash, dogwood, and beech. Bottomland hardwood stands are especially important. Even narrow streamside management zones with intact canopies can provide travel lanes through otherwise unsuitable landscapes.

One landscape-scale consideration is to manage hardwood and pine forests on a long rotation to minimize the area of young forest stands that turkeys avoid. Pine stands should be thinned and burned frequently to maintain an open midstory (keep visibility high) and to increase the variety of plants in the groundcover. Turkeys use openings, crop fields, and grasslands extensively, and, ideally, between 10-50 percent of the landscape should be in openings.

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When managing openings in forested landscapes for turkeys, it's important to consider year-round needs. Brood habitat is generally low-growing grasses or forbs that are open enough to allow the young birds to move freely through them. Openings can be maintained by burning, mowing, grazing, or rotating grain and legume crops. Openings managed for brood habitat should be several acres in size and are better if they contain scattered trees and an occasional clump of low-growing shrubs, vines, or brambles that can provide escape cover, shade, and soft mast. Wide fire lines and access roads that are maintained in wheat or legume crops can be an important resource during the spring and summer and during mast shortages.

Detailed information on managing food plots for wild turkeys is available at *Growing and Managing Successful Food Plots for Wildlife in the Mid-South* (University of Tennessee Extension).

White-tailed Deer

Food

Deer eat a variety of plant materials. Green leaves, buds, and flowers are browsed. They also feed on acorns, grains, berries and fruits, and mushrooms. Conflicts frequently arise because deer feed on agricultural crops and ornamental plantings.

Cover

Deer often spend the daylight hours in thickets and young forests with high-stem density. They are most active early, late, and at night and use edge habitats effectively to elude predators.

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Reproduction

One buck will breed with several does, and one doe may breed with more than one buck. Fawns are dropped in May-July, with the peak around June 1. Does can give birth to one to four fawns. Young does occasionally have single fawns, while older does frequently have twins. Triplets and quadruplets are not common. Fawns are dependent on does for nursing for approximately 10 weeks.

Home Range and Survival

Deer home ranges average about 1 square mile (640 acres), but are highly variable. Home ranges are largest for adult bucks and during the breeding season. Over half of yearling bucks disperse from two to 30 miles. Average distance moved for dispersing individuals is around five miles. In a heavily hunted population, average life expectancy is less than two years for bucks but typically greater than two years for does.

North Carolina land managers and hunters expend more time and energy on land management for deer than any other wildlife species. Deer are primarily browsers and are able to exploit a variety of foods and habitats during the year. What deer eat depends on the types of food available, food abundance, and time of year. They are also mobile and can travel considerable distances to reach food or cover in areas that are poorly connected to each other.

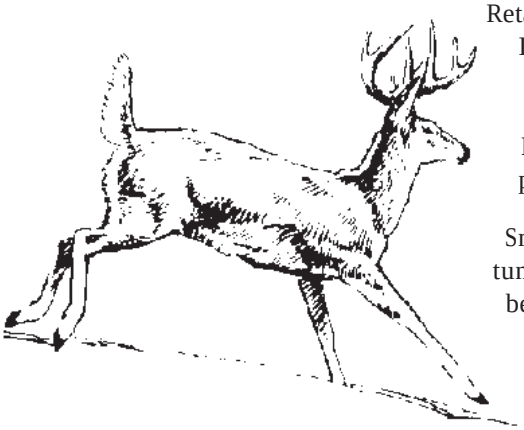
Deer are widespread and abundant, and one of the greatest challenges of deer management is to attain an adequate harvest. When deer populations are allowed to grow unchecked, they quickly reach densities that impact plant communities to the point that they and other wildlife species are negatively affected. Though the primary purpose of this publication is to address habitat management, it is worthwhile to stress the importance of killing does to reduce high deer densities and to reduce harvest pressure on antlered bucks, especially if the objective is to increase the number of mature bucks in the population.

Concentrated deer use at feeders can have negative implications. Concentrated use increases the potential for spread of disease and also damages the nearby understory plant community with overbrowsing.

Forest Management Considerations for Deer

At its most basic level, forest land management for deer should be concerned with providing a variety of foods that are within reach of deer (four feet or lower). Because deer use browse resources during much of the year, it is critical to encourage low-growing forbs, shrubs, and saplings to provide foods when mast is not available. In forested landscapes, frequent disturbance by timber harvest and burning is required to keep browse resources within reach of deer. Without disturbance, browse resources are shaded-out or quickly grow out of the reach of deer.

Variety is also important when considering browse resources. The greater the variety of mast-producing trees, the more likely one or more of the species will produce during any given year.



Retaining areas of dense cover is an important deer-management strategy. If burning large areas for deer, consider retaining some areas of dense, young regeneration or thickets for bedding cover. Livestock and deer compete directly for food, and heavy livestock use eliminates cover. Livestock can be excluded by fencing woodlots. Native grasses can provide fawning, bedding, and escape cover in open landscapes.

Small clear-cuts can be used to provide food, cover, and hunting opportunities through time. For example, if a 100-acre tract is clear-cut, there will be abundant browse for five to 10 years. The stand will then go through a stage where browse resources are limited by shade from the forest canopy and cover is so thick that hunting may be difficult. If the same 100 acres were broken into 20-acre management units that are clear-cut at 10-year intervals, there will always be an abundance of browse, cover, and stands open enough to facilitate harvest.

Clear-cuts and young forest plantations are often boom-then-bust for harvesting deer. They are great places to see and harvest deer for the first few years. Then they become a great refuge but a challenge to hunt for 10-15 years until they are thinned. By planning ahead, you can provide hunting opportunities throughout the life of the stand. Consider the following ideas when planning clear-cuts or planting forest plantations:

- Hunting opportunities can be enhanced by leaving islands of mature mast producers one to two acres in size when clear-cutting. Groups of trees are preferred to scattered or isolated mast trees because single trees suffer high mortality, and clumps of trees one to two acres in size are large enough to retain an open midstory. Clumps or islands of mast producers with adjacent shooting lanes or food plots in the young regenerating forest will provide excellent hunting locations while the surrounding stand is too dense to hunt.

- Plan wide firebreaks, food plots, or shooting lanes when planting young forest plantations, clear-cutting, or thinning. Maintain these openings by clearing and planting food plots or by spot-spraying or cutting regenerating trees. See *Increasing Pine Plantation Wildlife Habitat and Recreational Value with Hub and Spokes* (Wildlife Trends) for a discussion of some management options that provide hunting opportunities in young plantations.

Food plots for deer are more effective if located near areas of heavy cover such as young forest stands, brushy draws, native grass stands, and thickets. Screen food plots from roads or other areas frequented by people by leaving or planting a band of tall shrubs, native grasses, or evergreen trees. Food plots that are located near other fall and winter foods such as mast-producing hardwoods are often more productive. Because considerable annual expense will be devoted to planting and maintaining food plots, locate them on the most fertile sites you have available. Take soil samples and follow recommendations for lime and fertilizer in food plots as you would any other agricultural crop.

There are a number of excellent resources available that discuss crops suitable for food plots and how to plant and manage them. One excellent publication is located at G*rowing and Managing Successful Food Plots for Wildlife in the Mid-South* (University of Tennessee Extension). Unfortunately, there are some exaggerated claims by folks who sell seed for food plots, deer food pellets, and mineral supplements. So use common sense; if it sounds too good to be true, it usually is.

STEVE MASLOWSKI

Mourning Dove

Food

Doves are primarily seed eaters. They eat a variety of crop, weed and grass seeds.

Cover

Nesting usually occurs in trees though, occasionally, nests also are found on the ground. Doves nest in a variety of locations but frequently choose evergreens such as pine and cedars. Doves prefer feeding areas with light or no plant litter covering the ground surface.

Reproduction

Doves nest five or six times per year and lay two eggs in each nest. Eggs are incubated by both sexes for about 14 days before hatching, and young fledge in 13-15 days.

Home Range and Survival

Mourning doves are migrants, with birds from the mid-Atlantic states and New England wintering in North Carolina. The birds that summer in North Carolina move southward, but remain in the southeastern states. Nesting birds will feed up to one mile from the nest. Mortality averages about 60 percent annually.

Morning doves are found statewide but are most abundant in agricultural landscapes. Unlike quail, doves have the ability to cross miles of unsuitable habitat to exploit resources, so they can feed in fields that are isolated from nest and roost sites and other cropland. Doves are common in many habitat types ranging from farmland to suburban landscapes and most nests are in trees, on hedgerows, and in woodland edges. Most dove management is geared to attract birds for hunting.

Doves are migratory and congregate in flocks. Generally flocks begin forming in midsummer and populations appear to peak in late summer and early fall. The flocks are mobile from mid-September through winter. Movement of flocks can be a blessing if they show up on your field the day before the season, or a curse if they abandon your field shortly before your planned hunt.

Most dove management consists of manipulating agricultural crops or planting food plots to attract birds for hunting. Some homeowners feed doves at bird feeders. The key to attracting birds is to provide abundant seeds and bare ground. Good agricultural crops for attracting doves are sunflower, corn, milo, buckwheat, millet, and wheat.

Fields for hunting can be prepared by mowing, light disking, spraying with herbicide, dragging down, or burning crops to place seed on bare ground. Rotate crops or field locations or use herbicides to control grassy weeds such as crabgrass and fall panicum because they compete with crops and form a thick thatch that buries seeds out of reach.

Timing is everything when it comes to doves. If crops ripen or fields are prepared too long before the planned hunt, birds may eat most of the seed and leave the area. If crops are ready too close to the hunt date, birds often don't have time to locate foods. A good plan is to prepare a few strips to begin attracting birds about one month before the planned hunt and prepare the remainder of the area one to two weeks before the hunt.

Forest-management practices such as thinning and burning maintain an open canopy, provide bare ground, and encourage seed-producing grasses and forbs to benefit doves. Natural stands of pokeweed in young pine plantations sometimes attract large numbers of doves.

Songbirds

Learning to identify and appreciate songbirds and managing land to benefit them can add to the enjoyment of owning property. Most of the practices discussed in this publication can be tweaked to benefit one or more species of declining songbird. Managing to provide habitats that contain adequate food, cover, and space to support declining songbird species can help to stabilize local populations. Changes on a regional scale will be required to reverse long-term declines.

Opportunities to benefit declining songbirds are numerous. Landowners may find it rewarding to add to their knowledge of the natural history of the many bird species that share their land. Following are three examples of birds that are still widespread on working farms and forests, but are experiencing long-term population declines. Note the similarity between population declines, habitat requirements, and management recommendations for these birds and those of the quail whose population has averaged a 4.2 percent annual decline in the southeast since 1966.

Prairie Warbler

Status
Prairie warbler populations are declining throughout their range. Declines in the southeast U.S. averaged 1.9 percent annually over the past 40 years.

Habitat Description – Early Succession Shrub/Scrub Habitats
Prairie warblers are actually not a prairie species, but inhabit young regenerating forests, open canopy forest with lots of low-growing shrubby understory, and overgrown old fields and rights of way. The common thread is that preferred habitats are dominated by shrubs and saplings.

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Management Recommendations

Use frequent overstory thinning to allow sunlight to reach groundcover, and control midstory hardwoods by prescribed burning on a one- to three-year rotation. When regenerating forests, avoid controlling all woody plants with intensive herbicide applications. Maintain rights of way and old fields by disking or burning on a three- to five-year rotation.

The following birds have similar habitat requirements as the prairie warbler at some time of the year: common yellowthroat; yellow-breasted chat; Eastern towhee; white-throated sparrow; dark-eyed junco; American woodcock; quail; golden-winged warbler (which is restricted to high elevations); and painted bunting (which occur only along the coast).

Grasshopper Sparrow

BRADY BECK

Status

In the southeastern U.S., grasshopper sparrow populations have suffered on average a 3.9 percent decline annually since breeding bird surveys began in 1966.

Habitat Description – Large Openings Dominated by Short Grasses

Grasshopper sparrows inhabit areas of short grass, six inches to two feet in height, interspersed with patches of open ground. Optimum habitat consists of an open mix of clump grasses, forbs, and patchy openings with few shrubs. Grasshopper sparrows require openings of 25 acres or more and prefer much larger openings within which woody vegetation is sparse.

Management Recommendations

Management opportunities are restricted to open landscapes dominated by grasslands or cropland. Maintain a mosaic of habitats dominated by grasses around one foot in height by light grazing, disking, and burning patches of short grass. Conduct management activities outside of the nesting season. Management will be more effective on infertile sites where sparse stands of grass can be easily maintained. Where possible, configure habitat in large blocks, rather than narrow strips, to reduce nest predation.

The following birds have similar habitat requirements and will benefit from management activities directed toward the grasshopper sparrow at some time of the year: Eastern meadowlark; barn owl; loggerhead shrike; American kestrel; and savannah sparrow.

Field Sparrow

STEVEN BULLOCK

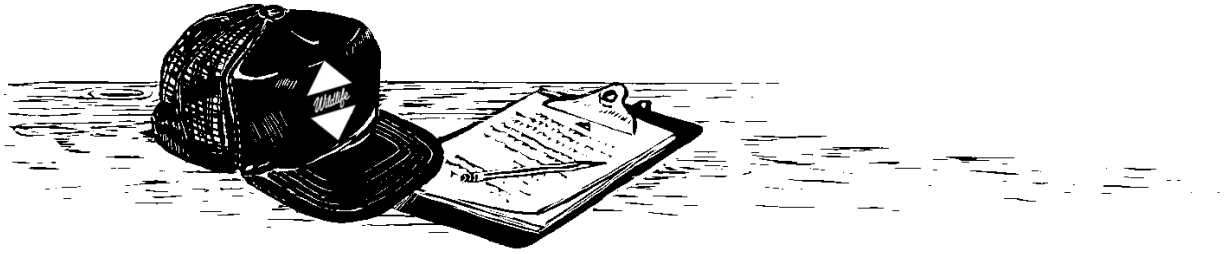
Status
Field sparrows have undergone long-term declines averaging 2.4 percent per year for the past 40 years.

Habitat Description – Tall Grass Interspersed with Shrubs or Young Trees
Breeding habitat consists of old fields with tall grass and scattered young trees, native grass or weedy pastures, and young pine plantations with a grass-dominated groundcover.

Management Recommendations
Field sparrows require openings of a minimum of 5 acres. Manage native grasses with fire, light grazing, or rotational disking to prevent trees from overtaking the area. Though field borders are important winter habitat, where possible, configure habitat in large blocks, rather than narrow strips, to reduce nest predation.

The following birds have similar habitat requirements as the field sparrow at some time of the year: Eastern kingbird; quail; Eastern towhee; indigo bunting; blue grosbeak; song sparrow; common yellowthroat; and brown thrasher.

9 Wildlife Management Technical and Financial Assistance



The North Carolina Wildlife Resources Commission (NCWRC) employs biologists devoted to private lands issues. These professionals can provide assistance on a variety of land-management issues, including habitat management for game and nongame species. Biologists are available to assist with workshops and to meet with groups of landowners with similar management goals. Contact NCWRC's Division of Wildlife Management (919) 707-0050 for the name and phone number of the appropriate biologist to assist with your project.

The N.C. Wildlife Resources Commission also provides literature on a variety of private lands management issues, including the *Upland Gazette*, which focuses on early-successional habitats and small game issues. Commission biologists also can provide information on the current availability of state and federal cost-share programs to assist with selected management practices.

NCWRC has entered into a cooperative agreement with the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) to establish biologist positions in each of North Carolina's three Regional NRCS offices. They work with Federal Farm Bill programs: the Conservation Reserve Program (CRP), the Environmental Quality Incentives Program (EQIP), the Wildlife Habitat Incentives Program (WHIP), the Wetlands Reserve Program (WRP), and other programs as needed. These Farm Bill programs provide a variety of cost-share programs to assist landowners with wildlife habitat management. Contact your local USDA Service Center for more information about these programs.

Programs under the Farm Bill offer opportunities ranging from cost share for forest and field-management practices to benefit wildlife, to annual rental payments for unproductive field edges converted to wildlife habitat, to payments for restoring drained farm and forest land back to wetlands. North Carolina landowners have used Farm Bill Programs successfully to accomplish wildlife management goals. However, programs and funding opportunities change frequently. Fortunately, NCWRC wildlife biologists, the local staff in USDA Service Centers, and USDA Web sites provide up-to-date information on current opportunities.

Three sources of conservation technical assistance and cost share are housed together in USDA Service Centers located across the state. The Natural Resource Conservation Service (NRCS) provides leadership in the conservation of soil, water, air, plant, and animal resources. The NRCS offers technical assistance, cost share for selected practices, and cooperative conservation programs to landowners and land managers. Working closely with NRCS are Soil and Water Conservation Districts (SWCD). SWCD provide technical assistance and cost-share incentives to landowners to install a variety of best management practices through state and federal conservation programs. The NC Farm Service Agency (FSA) administers and delivers several price-support, farm-loan, and farm-assistance programs including conservation programs. The best known is the Conservation Reserve Program, which includes a variety of practices designed to improve conservation of crop and pastureland.

Program information specific to North Carolina can be found at the NC Farm Service Agency Web site.

Visit *www.ncwildlife.org/tarheelwildlife* or see Appendix D for links and more information.

The U.S. Fish and Wildlife Service [USFWS] Office of North Carolina Ecological Services works to protect endangered and threatened species, migratory birds and migratory fish, and wildlife habitat in North Carolina. Their biologists administer several programs that provide technical assistance to private landowners. The Partners for Fish and Wildlife Program is the USFWS's primary mechanism for delivering voluntary on-the-ground habitat-improvement projects on private lands for the benefit of federal trust species. [See *North Carolina Red-Cockaded Woodpecker Safe Harbor Program* for information and contacts concerning longleaf-pine management. The Safe Harbor Program also can assist landowners with management of the red-cockaded woodpecker on private lands.]

The North Carolina Division of Forest Resources (NCDFR) provides technical assistance on forest management and administers some state and federal cost-share programs related to forest management. The NCDFR also can directly facilitate prescribed burns through fire-line construction and conducting burns.

The North Carolina Cooperative Extension Service offers landowners and citizens access to the resources and expertise of N.C. State University and N.C. A&T State University. Cooperative Extension field faculty offer educational programs and publications and also provide landowners with research-based answers to management questions.

Financial Incentives and Assistance Programs

Financial incentives available to landowners vary from year to year depending on available funding. There are numerous state, federal, and private programs that can facilitate wildlife management. When you have a management plan in place, check with agencies and organizations concerning programs, incentives, and sign-up dates. Federal and state programs often have rigid technical specifications and inspections to assure that program goals are met. Patience is frequently required to negotiate the maze of forms, agreements, and audits that accompany government conservation programs.

Contact the Partners for Fish and Wildlife Program, U.S. Fish and Wildlife Service for information concerning longleaf pine management including the Safe Harbor Program, which can assist landowners with management of the red-cockaded woodpecker on private lands.

Private conservation organizations that are active in North Carolina and can provide landowners with helpful information include:

Audubon North Carolina
Conservation Trust for North Carolina
Ducks Unlimited
Eastern Native Grassland Alliance
Longleaf Alliance
National Bobwhite Technical Committee
National Wild Turkey Federation
North Carolina Prescribed Fire Council
North Carolina Wildlife Federation
Quail Forever
Quail Unlimited
Quality Deer Management Association
Ruffed Grouse Society
Tall Timbers Research Station
The Nature Conservancy

These organizations can be located online at www.ncwildlife.org/tarheelwildlife.

Visit ***www.ncwildlife.org/tarheelwildlife*** or see Appendix D for links and more information.

10 Wildlife Management Practices

Quick Fixes–Silver Bullets and Magic Beans

Almost every week we hear about a shortcut that will let us quickly reach some wildlife management goal. Some weeks it's a new technique for stocking pen-raised quail that assures they survive and repopulate our farms. Other weeks it is a high-protein feed mix or mineral supplement that increases antler size in our white-tailed deer herds. Each spring and fall advertisements proclaim the latest and greatest plant materials to grow big bucks or increase quail and turkey populations.

These claims usually share some common threads. First, someone is making money from them. Second, they have not been rigorously researched. Third, promoters don't provide data to support their claims. Finally, they are promoted based on testimonials. It is helpful to do some research before committing to something that sounds too good to be true. Contact a NCWRC Division of Wildlife Management wildlife biologist at (919) 707-0050, the NC Cooperative Extension Service, or ask for research reports to support claims. Successful wildlife management programs are based on a well-planned program that addresses wildlife needs during each season of the year, not on silver bullets and magic beans.

Prescribed Fire

North Carolina's wildlife evolved and flourished in a rich and diverse landscape maintained by fires set by lightning and Indians and, later, early European settlers. Today, prescribed fire is an inexpensive tool that can be used to create and maintain habitat in old fields, native grasslands, and in open-canopy woodlands. Repeated fires create a diverse and structurally complex grass- and forb-dominated plant community favored by many species of wildlife. Fire removes the accumulation of dead plant material on the ground, facilitating movement of many species, and makes seeds available. Many woody shrubs benefit from reduced competition, a flush of nutrients, and the natural pruning provided by fire and produce more fruit two to three years following a burn. Fire releases nutrients tied up in dead plant material making it available to resprouting vegetation. Regrowth following fire contains higher nutrient levels and is preferred by browsers.

Many of our declining or rare plant and wildlife species are adapted to and found exclusively in plant communities that develop and persist under a regimen of frequent fires. Examples of fire-adapted natural communities are longleaf, shortleaf, pond, pitch, and table mountain pine-dominated forests; hardwood glades and savannas; prairies; and shrub-dominated bays and pocosins. Efforts to restore fire to these community types are a high priority on many public lands. Private lands also can be managed to encourage fire types and can contribute to regional conservation efforts when landowners implement complementary management strategies.

Restoration burns should be distinguished from maintenance burns. In older forests that have been fire suppressed for many years, a heavy layer of litter and duff around mature trees can present management problems. Reintroduce fire cautiously and conservatively in fire-suppressed forests with a heavy duff layer to prevent mortality of overstory trees. Smoldering duff can cause mortality, and a number of low-intensity fires may be required to slowly reduce the organic layer before groundcover can be restored. Seek assistance from experienced land managers prior to initiating burns in a fire-suppressed stand of mature trees.

Growing-season fires will set back hardwood brush more effectively than winter burns but should be conducted in stands with light to moderate fuels to prevent damage to overstory trees. Late winter or early spring burns minimize the time an area is bare of cover and are preferred to burns conducted in early winter, which result in deficient cover and browse until spring green-up. Summer burning can be a useful tool, where hardwood sprouts are difficult to control, with winter or early spring fires, and as a tool to increase the forb component in fields where native grasses have become too thick. Late summer or fall burns can increase the open ground and forb component in grasslands. Use care when late summer and fall burns are used in pine forests as they can result in overstory mortality.

Repeated burns are necessary to restore and maintain fire-adapted plant communities. Every one to two years is ideal to provide the open groundcover preferred by quail and many grassland birds; two to four years is adequate for deer and turkeys. Burning in a checkerboard pattern in blocks of 10-50 acres is recommended. This practice will increase the interspersion of food and cover resources. Recently burned blocks provide more nutritious browse and higher insect populations. Blocks with one to two years of plant growth, since the last burn, provide concealment, nesting and fawning cover, and fruits, berries and seeds.

Prepare permanent fire lines that you can maintain with your equipment. Opportunities to establish permanent fire lines are presented when equipment is on site for establishing new pine plantations, when thinning existing stands, and when clearing land.

Using Fire Responsibly

Using prescribed fire carries the responsibility to keep fires on your property and manage smoke so that it does not become a safety or health hazard. Practitioners should work with experienced burners before becoming the lead person on a fire. Contact the North Carolina Prescribed Fire Council for suggestions and links to using fire safely, effectively and responsibly.

JEFF MARCUS/NCWRC

Visit ***www.ncwildlife.org/tarheelwildlife*** or see Appendix D for links and more information.

Food Plots

Food plots should be viewed as a complement to overall habitat management but, without proper planning, they do not provide great benefits for breeding, escape, and other types of cover. A food plot of clover or winter annuals will provide green forage for turkeys and deer. Grains standing after maturity can be an important food source for many species. In addition to providing browse or seed foods, food plots can attract an abundance of insects for turkey poults or quail chicks. Plots can be an important tool to enhance hunting opportunities.

Openings can be shaped to facilitate hunting, to take advantage of areas with more fertile soils, or to double as fire lines. When managing for deer or small game, feather edges (page 64) or thin woodlands adjacent to openings to a basal area of 40 square feet per acre or lower to encourage ground cover. Work with loggers to plan locations of logging decks and access roads, which can provide locations for future food plots to complement your wildlife goals. Openings to be used as food plots should be placed where they are not visible from ungated roads.

Green browse plots designed to benefit deer and turkey should be at least one-fourth acre in size and about one-fourth mile apart. Locate plots on relatively level sites with fertile soils. The site should be open, tillable, and located next to suitable cover. Placing the plot at least 30 feet from any mature woodland edge will reduce competition from trees and allow sunlight to reach the planting. A buffer strip of perennial weeds and shrubs will develop between the browse plot and timber over time, if introduced grasses are not present. Rotating plots across larger openings will reduce weed problems and encourage volunteer plant communities that provide benefits of cover and a greater diversity of plant and insect foods.

Ideally, fall food plots for rabbits will be no-tilled into standing weeds (before planting, weeds can be killed with an application of glyphosate), surrounded by dense cover, and located about 100 yards apart. Plots that attract rabbits to areas where they can be seen by predators are not a productive endeavor, so avoid plantings along woodland edges, long straight plots, and plots visible from standing snags or woodland edges that can provide predator perches.

Aside from browse plots for rabbits, where cover takes precedent, don't take shortcuts on preparing a seed bed for your food plot. For fall planted plots, prepare the seed bed in September or early October. The ground should be plowed and disked until no live vegetation exists. Correct fertilization is essential for the successful establishment and maintenance of the browse plot. Before planting, obtain a soil sample from each plot site. Visit your USDA Service Center or NC Cooperative Extension Service office to obtain supplies and instructions on taking soil samples. Soil sample results will provide recommendations for liming and fertilization. Ideally, lime should be added during the spring, prior to planting in the fall and, on most North Carolina soils, lime is essential for successful clover plantings.

Avoid perennial-introduced grasses like fescue, orchard grass, Bahia grass, and Bermuda grass for wildlife plantings. They produce poor overhead cover. In addition, stands of these grasses are too dense at ground level for small birds and animals to negotiate, they leave little room for other valuable plants to become a part of the stand, and they often spread into areas where you do not want them. Finally, plants that produce higher quality browse are available.

There is a host of options available to choose from when selecting plant materials. Consider your objectives for planting the plot. Dove plots should be timed so that crops ripen shortly before your planned hunts. Quail and rabbit food plots should consider vertical structure that will stand throughout the winter to provide screening from predators. If planting for turkey brood habitat, consider leaving or adding clumps of blackberry or plums for escape cover and to provide soft mast. Also determine the food resources available in the surrounding landscape, the soil and site conditions, planting equipment, and your budget. *Growing and Managing Successful Food Plots for Wildlife in the Mid-South* (University of Tennessee Extension) provides an excellent discussion of planting materials, food plot planting techniques, and maintenance.

Fallow Disking

Fallow disking is a practice designed to set back plant succession, encourage a volunteer plant community that has favorable structure for cover and foraging habitat, and provide plant and insect foods for wildlife. Fallow disking can also be used to discourage woody plant invasions in field borders, old fields, and openings. The plant community that develops after disking will depend on the time of year the soil is disturbed and the seed bank present in the soil.

DEAN SIMON/NCWRC

Early-succession habitat managed with light soil disturbance and periodic prescribed fire.

The plant community that we most often hope to encourage is composed of volunteer large-seeded annuals and perennials. Fall or winter disking often encourages ragweed, partridge pea, native sunflowers, native grasses, and beggar's lice in woodlands and old fields with little history of herbicide use.

If your land has a long history of herbicide use, it may take several years for a seed bank of desirable plants to develop. In that case, wheat or rye can be planted at one bushel to the acre in the fall, or partridge pea, Kobe or Korean lespedeza, or native wildflowers can be seeded at three to five pounds per acre during the winter. After one or two cycles, dormant season disking should result in desirable volunteer plant communities without further seeding.

If the site is occupied by fescue, orchard grass, Bahia grass, or Bermuda grass, the grasses should be killed by one or more applications of the appropriate herbicide prior to initiating fallow disking.

Edge Feathering and Woody Cover Establishment

Edge feathering is a technique used to encourage dense woody escape cover. When applied adjacent to early-successional habitat on field borders, fallow areas, or weedy rights of way, edge feathering provides loafing and escape cover for quail, rabbits, and songbirds, as well as a secure area during winter storms.

Edge feathering can be implemented on any overgrown ditch bank, hedgerow, or woodland edge. Ideal areas are dominated by low-value hardwoods such as sweetgum, scrub oaks, maple, or water oaks. Areas should be between one-tenth and 1 acre in size, and ideally they should be spaced 50-100 yards apart around field edges. If exotic grasses are present in the area, kill them with an approved herbicide prior to cutting trees.

Edge feathering is tough work, typically accomplished with a chain saw, and care should be taken to assure that it is accomplished safely. Fell all trees over 15 feet tall parallel to the woodland edge and leave them loosely piled. Treat stumps of felled trees with herbicide to prevent resprouting. The goal is to create heavy cover at ground level, so leave no more that one fruit or mast tree per one-tenth acre. It is important to re-treat the area every five to seven years or when the regrowth reaches 15 feet tall and the area begins to open up at ground level.

A variation of this practice can be used to create hedgerows or cover islands in idle fields or wildlife openings. First, mark off and kill exotic perennial grasses in the area that will become woody cover. Cut trees along woodland edges or in nearby woodlands. Drag trees or tops to the location where you want to develop cover and arrange them in a loose hedgerow or island. By the end of one growing season, you will have a woody thicket with an understory of weeds and grasses growing. Blackberry and other fruiting shrubs and trees will volunteer within a few years.

For more information on edge feathering, see *Edge Feathering Job Sheet* (Natural Resources Conservation Service).

"Living" brush piles may be constructed for long-lasting shelter. These are created by cutting partway through small trees and shrubs so that the tops fall to the ground, but enough stem remains uncut on each tree to keep it alive. If the trees are cut to fall in a crisscross pattern over each other, a living brush pile is created. Brush piles of this type are loosely formed. Those built for rabbits can be made denser by using the bases of cut trees as foundations and piling dead limbs and brush over them. Care should be taken to leave the live tops of the half-cut trees uncovered so they will continue to grow. Either deciduous trees and shrubs or conifers may be used. Grapevines should be encouraged to grow over the brush pile for added cover.

Brush piles and woody cover add a valuable dimension to wildlife habitat on your land. If properly located and constructed, they will provide important critical escape cover. However, it should be noted that heavy cover areas are not permanent. Tree growth, rot, and decay will reduce their effectiveness over time. To provide adequate escape cover through time, maintain existing cover and add new areas on an annual basis.

Using Herbicides for Wildlife Management

Herbicides used today have little direct effect on wildlife when used according to label instructions. However, when their use results in less complex plant communities or removes valuable cover, wildlife is impacted by having less food or greater exposure to weather and predators. Herbicides used appropriately are a useful tool to create and maintain wildlife habitat.

Always read and follow label instructions. Herbicide labels contain important information relating to wildlife, environmental, and human safety. Labels which contain detailed information on how to safely apply and use herbicides can be found at *Crop Data Management Systems Agro Systems Data Base*.

Consider application options to target specific pest plants. Application options vary with each chemical but include basal bark, hack and squirt, thinline, broadcast of granular materials, applying spots to the soil on a grid pattern, or foliar. Herbicides can be applied to individual stems, broadcast by ground equipment, or applied aerially.

Ideas and Concepts to Consider When Using Herbicides

Herbicides can be an effective means to control introduced perennial grasses prior to establishing food plots, native grasses, or other early-successional plant communities. If perennial grasses are present, you should plan well in advance as multiple treatments or treatments during a specific time of year may be required to target species when they are most susceptible to herbicides.

Herbicides can be used to control hardwood saplings and resprouts. Herbicides cannot replace prescribed fire, but when used in combination with prescribed fire, they can encourage grass and forb communities in open woodlands. If using fire in combination with mid-rotation herbicide applications in open canopy forests, burn in the spring following herbicide application to stimulate groundcover by reducing the litter depth. Careful evaluation of stem density and susceptibility of problem species (the ones you want to control), as well as susceptibility of nearby overstory trees (the ones you want to protect), should precede application.

Many herbicides target specific plant species for control. Assess weed problems and read labels carefully to determine your options for controlling specific weeds in specific crops. Carefully study the mode of action and characteristics of the herbicide. It is important to know if it is soil active or only absorbed through foliage, whether it is volatile in warm temperatures, and whether it moves downhill when it rains or translocates to other non-target plants. We now have an array of options for increasing the productivity or the longevity of food plots by properly applying herbicides.

Lower rates may sometimes be used to remove susceptible seedling plants without damaging surrounding beneficial plants. Consider time of year as some species may be more vulnerable during late summer when nutrients are being stored for winter. Some pest species (fescue for example) present an opportunity for control by staying green longer in the fall or by greening up earlier in the spring than surrounding beneficial plants. Always use herbicides and surfactants labeled for aquatic use when managing vegetation along ditches that contain water.

Herbicides are an effective tool to remove encroaching brush and control grasses as part of a maintenance program on fire lines, boundary lines, field and food plot edges, shooting lanes, and access trails. In summary, herbicides are a valuable tool in the land manager's toolbox. But like any other tool they must be used carefully. Used carelessly or inappropriately they can damage wildlife habitat and present safety concerns.

Northern Red Oak

Native Plants for Wildlife

North Carolina is host to thousands of species of native plants. Communities of these plants at one time provided all the food and cover needs of our wildlife. We have attempted to improve upon Mother Nature by introducing many species of plants from other parts of the world. Many introduced plants have become valuable agricultural and ornamental species. Most agricultural species pose no problems and some are valuable tools to enhance areas for wildlife or to control erosion. However, a number of introduced exotics have become serious invasive pests that degrade habitat conditions and pose a threat to native plant communities. Additionally, there is another more subtle link between native plants and wildlife. Almost all of our native terrestrial birds depend on insects for survival. Researchers are finding that insect diversity is almost always lower on exotic plants than on the native plants they replace, thus reducing food resources that are essential to many species of birds.

Examples of plants introduced for conservation or wildlife management that have become invasive include sericea lespedeza, bicolor lespedeza, kudzu, autumn olive, multiflora rose, and oriental bittersweet. Responsible land managers will research plant materials before using them and select native species.

Water Oak

White Oak

Visit ***www.ncwildlife.org/tarheelwildlife*** or see Appendix D for links and more information.

Avoiding Invasives

Invasive Plants to Avoid	*Native Plants with Similar Attributes*
Bicolor Lespedeza & Shrub Sericea Lespedeza	Bristly locust (spreading shrub) Partridge pea (large-scale erosion control; quail food and cover) Native lespedezas – slender & roundhead (small-scale erosion control; quail food)
Japanese Honeysuckle Oriental Bittersweet	Coral honeysuckle, Trumpet creeper (nectar) Virginia creeper, Muscadine grape (deer browse, fall fruit) American bittersweet (colorful winter berries)
Oriental Privet Multiflora Rose Autumn Olive & Eleagnus	American holly (evergreen; winter fruit for birds) Hawthorn (winter fruits; thorns protect nesting birds) Chickasaw & American plum (summer fruit; thorns protect nesting birds)
Sawtooth Oak	Chinquapin, hazelnut (hard mast in less than 10 years). Shingle oak, white oak, northern red oak, or others of the 30+ species of native oaks. (variety of growth forms, time until maturity, and acorn characteristics)
Chinese Silvergrass (Miscanthus) Weeping Love Grass	Indiangrass, switchgrass (bunchgrass suitable for ornamental plantings and wildlife cover) Prairie dropseed, pink muhly grass (ornamental and small-scale erosion control)
Fescue, Orchard Grass, Bahia Grass	Purpletop (looks similar to fescue, erosion control) Big Bluestem (high quality hay)

Native Grasses

Desirable native shrubs, trees, and mixes of native grasses and forbs can be established by planting seeds or seedlings. Plantings of locally adapted species that originate in the same region as you are planting such as southeast Piedmont, southeast Coastal Plain, or southern Appalachian region are preferred if planting for wildlife or to accomplish conservation goals. For assistance in locating shrubs, trees, native grasses and other planting materials for wildlife, see *Commercial Sources for Wildlife Planting Materials* (North Carolina Wildlife Resources Commission).

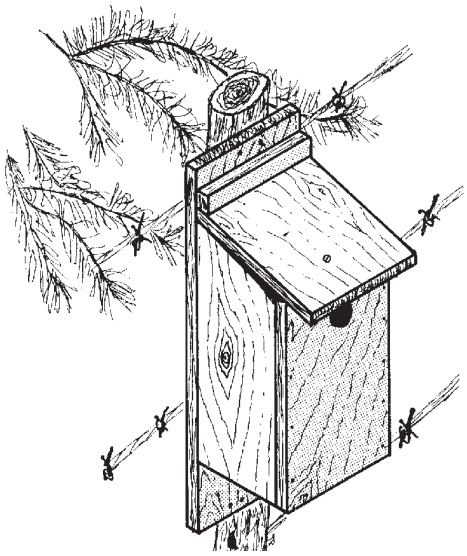
Nest Boxes

The North Carolina Wildlife Resources Commission has an excellent publication on wood ducks, *North Carolina Wood Ducks Natural History and Management* (NCWRC Division of Wildlife Management), available on the Web. The publication covers wood duck natural history and contains plans for constructing a wood duck nest box and predator guard.

Constructing bluebird boxes is a popular building project. The publication *Bird Houses and Feeders: How to Build and Enjoy Them* (NCWRC Division of Conservation Education) contains plans for a number of bird houses and feeders, including plans for a bluebird box. Information more specific to bluebird nest-box placement, spacing, and predators is available at *Eastern Bluebirds Nesting Structure Design and Placement* (University of Kentucky).

The bluebird nest box design is also suitable for wrens, chickadees, titmice, nuthatches, or even flying squirrels. If you want to attract these species, place the box in trees 10 to 15 feet above the ground in wooded areas. Place this nest box on poles or in dead trees located in or over water to attract prothonotary warblers.

See *Homes for Wildlife II Plans* (Michigan Private Land Partnerships) for details on how to build and install squirrel den boxes from wood or discarded auto tires.



Feeding Birds Responsibly

Backyard feeders can benefit many bird species, as well as provide excellent opportunities for birdwatching. Landscaping with native plants that provide more dispersed food and cover and supplying a dependable water source are sustainable additions or alternatives to feeding that benefit an even greater variety of birds.

Place feeders in a location that minimizes the opportunity for bird collisions with windows and adjacent to suitable cover, such as native evergreen shrubs or loosely piled brush. The seed in your feeder attracts hungry seed-eating songbirds. Similarly, a concentration of songbirds will attract predators. Keep cats indoors. Provide escape cover nearby and take measures to prevent nest predators such as raccoons and gray squirrels from using feeders. Temporarily close feeders if you notice a pattern of predation by raptors.

Clean feeders regularly and only use high-quality food. Never use food that is moldy or spoiled. Close feeders if you find evidence of disease. Finches and doves are particularly susceptible to diseases transmitted at feeders. Not all species benefit from feeders. Many songbirds use insects or foods that are difficult or impossible to supply. Remember that only those species that use the food you supply will benefit, and they benefit only when food is the limiting factor and its availability outweighs the contribution of the feeder to mortality. If feeders attract blue jays, house sparrows, flying squirrels, or brown-headed cow birds, you may be increasing the mortality of local songbirds by encouraging higher nest predation, nest parasitism, or competition for nest sites.

11 Measuring Progress

Rarely do we appreciate the importance of measuring progress when we begin a new endeavor. Usually, it is only after a few years, when the original details have grown a little fuzzy, that we say, "I wish I had taken some photos before I started, or how much did that big deer weigh, or when did that covey of quail show up on the ditch bank." The point is that efforts taken up front to document plant communities with photos, keeping a bird journal, or maintaining a hunting diary become more valuable as time passes.

The type of information to record depends on your interests and objectives. But consider maintaining a diary, map, or photographs to record sightings, cover types, bird call counts, before- and after-shots of burns or timber operations, and hunting records.

Songbird point counts, searches for reptiles and amphibians, and plant transects are examples of surveys for which protocols have been developed. Spring quail counts and fall covey counts are used to document quail presence and activity. Recording winter songbird sightings and dates of arrival and departure for migrant birds can become a worthwhile hobby and lead to greater understanding and appreciation of their natural history and habitat requirements. Learning to recognize and record the detection of reptiles, amphibians, or butterflies on your property can provide milestones to measure your management progress. Answering questions, such as "Am I seeing more species that require mature woodlands or grasslands?" will be helpful in evaluating progress. See Appendix C for monitoring protocols.

Keeping a Wildlife Calendar

Your understanding of what goes on around you can be enhanced by recording significant events on a calendar and comparing from year to year such things as rainfall, wildlife sightings, or peak bloom for specific wildflowers. Also, recording your management activities can be helpful for future planning or evaluation of work accomplished.

Appendix A. Glossary of Terms

basal area – A forestry term referring to the cross-section area of the trunks of trees, generally expressed as square feet per acre. In wildlife management, the basal area is a commonly used way to estimate competition of large trees with groundcover plant communities. Denser and higher-quality groundcover plant communities will be supported at lower basal areas due to increased sunlight reaching the ground.

carrying capacity – The population size of a species that the environment can sustain in the long-term given the food, habitat, water, and other necessities available in the environment.

duff – The layer of organic material that accumulates on the forest floor.

early-successional habitat – Plant communities such as young forests, native grasslands, weedy fallow fields, and scrub-shrub areas. These areas support plant communities that provide critical habitat for many species of wildlife. These are some of the most imperiled habitat types in North Carolina and the entire Southeastern United States.

early-successional wildlife – The group of species that inhabit plant communities such as young forests, native grasslands, weedy fallow fields, and scrub-shrub areas. Examples of these species include quail, rabbits, and many declining songbirds.

edge feathering – Cutting trees along crop field edges to create a wide transition zone from field to forest.

field borders – Strips of planted or volunteer vegetation along the edges of crop fields that provide food and cover for wildlife.

forbs – A broad-leaved herb other than a grass, especially one growing in a field, prairie or meadow.

keystone wildlife species – A species that has a disproportionate effect on its environment relative to its abundance. Such species affect many other organisms in an ecosystem and help to determine the types and numbers of various other species in a community. Examples include beavers and woodpeckers. Beavers construct ponds that provide brood habitat for wood ducks and support a diversity of aquatic organisms. Woodpeckers excavate cavities that many other species depend upon for nest sites and concealment.

mast – Woody plant (trees, shrubs, or vines) fruit used by wildlife for food. Usually referred to as hard mast (examples are acorns, hickory nuts, pine seeds, and beech nuts) and soft mast (grapes, greenbriar berries, dogwood fruits, black haws, and persimmons).

NC Cooperative Extension Service – Through educational programs, publications, and events, Cooperative Extension field faculty deliver unbiased, research-based information to North Carolina citizens.

pocosin – A type of wetland with deep, acidic, sandy, peat soils. Groundwater saturates the soil, except during brief seasonal dry spells and prolonged droughts. Pocosin soils are deficient in many nutrients, especially phosphorus.

United States Department of Agriculture (USDA) Service Center – Local office that houses the Farm Service Agency, Natural Resources Conservation Service, and Soil and Water Conservation District Office.

Appendix B. Wildlife Management Programs and Publications

Web links are time-sensitive and can expire. Find an updated list of Web links at www.ncwildlife.org/tarheelwildlife.

Forest Management

Edge Feathering Job Sheet (Natural Resource Conservation Service)
http://www.mo.nrcs.usda.gov/technical/forms/out/wildlife_js/JS-BIOL-18EdgeFeathering_408.pdf

Forest Landbird Legacy Program (U.S. Fish and Wildlife Service)
The Forest Landbird Legacy Program (FLLP) is a voluntary wildlife conservation program for private non-industrial forest landowners in all parts of North Carolina who want to manage their mature forests to benefit forest-dwelling landbirds. The focus of the FLLP is migratory "birds of conservation concern" identified by the Partners in Flight assessment for North Carolina.
http://www.fws.gov/nc-es/es/partners/factsheetlbl.pdf

Increasing Pine Plantation Wildlife Habitat and Recreational Value with Hub and Spokes (Wildlife Trends) by Hamrick, R.
http://www.coontailfarm.com/documents/PDFs/PDFs2/Hub%20and%20Spokes.pdf

Managing Pine Plantations for Timber and Wildlife by Kimmel, F. (Southeast Quail Study Group)
http://seqsg.qu.org/seqsg/docs/managingpine.pdf

North Carolina Red-Cockaded Woodpecker Safe Harbor Program (NCWRC)
http://www.ncwildlife.org/Wildlife_Species_Con/documents/nongame_rcw_landowners.pdf

Grassland Management

A Landowner's Guide to Native Warm-Season Grasses in the Mid-South by Harper, C., G.E. Bates, M.J. Gudlin, and M.P. Hansborough
http://www.utextension.utk.edu/publications/pbfiles/PB1746.pdf

Converting Common Bermuda Grass to Native Warm Season Grasses by Barnes, T.G. and B. Washburn
http://www.wildlifemanagement.info/files/nwsg_24.pdf

Handling the Fescue Problem by Sole, J. and P. Keyser
http://seqsg.qu.org/seqsg/docs/fescue.pdf

Using Plateau to Assist in No-till Establishment of Native Warm-Season Grasses by Barnes, T.G. and B. Washburn
http://www.uky.edu/Ag/Forestry/TBarnes/Assets/Plateau%20assist%20NWSG.pdf

Other Helpful Publications

A Guide to Creating Vernal Ponds by Biebighauser, T.R.
http://www.fs.fed.us/r8/boone/documents/resources/vernal.pdf

Going Native: Urban Landscaping for Wildlife with Native Plants (N.C. State University)
http://www.ncsu.edu/goingnative/

Herbicide labels
http://www.cdms.net/LabelsMsds/LMDefault.aspx?pd=7602&t=

North Carolina Wildlife Action Plan (NCWRC)
http://www.ncwildlife.org/plan/index.html

*Wildlife Damage Control (*NCSU Extension)
http://www.ces.ncsu.edu/nreos/wild/wildlife/wdc/

The following publications are available online through the N.C. Wildlife Resources Commission's Web site at www.ncwildlife.org.

- Beaver Management in North Carolina
- An Evaluation of Deer Management Options
- North Carolina Wood Ducks Natural History and Management
- Tarheel Wildlife
- The Wild Boar in North Carolina
- White-Tailed Deer in North Carolina
- The Wild Turkey in North Carolina
- Upland Gazette

Stay up-to-date with small game issues and wildlife habitat information in North Carolina with the *Upland Gazette* newsletter. This publication is produced twice yearly. Obtain your FREE subscription by calling (919) 707-0050 or writing to:

NCWRC
Division of Wildlife Management
1722 Mail Service Center
Raleigh, NC 27699-1722

See back issues of the *Upland Gazett*e at:
http://www.ncwildlife.org/Wildlife_Species_Con/WSC_Upland_Gazette.htm.

Appendix C. Monitoring Data and Protocols

Web links are time-sensitive and can expire. Find an updated list of Web links at www.ncwildlife.org/tarheelwildlife.

Visit the Breeding Bird Survey (BBS) (Patuxent Wildlife Research Center) at http://www.mbr-pwrc.usgs.gov/bbs/bbs.html to see bird species present and population trends through time from survey routes near your property.

To see examples of nongame surveys used by the NCWRC Division of Wildlife Management, visit http://www.ncwildlife.org/Wildlife_Species_Con/documents/AnnualProgramReportWDinWM07-08.pdf and click on the *Wildlife Diversity Program Annual Report*.

The North Carolina GAP Analysis Project provides information on distribution and abundance of most vertebrate species occurring in the state. Visit the NC GAP site at http://www.basic.ncsu.edu/ncgap/ and follow instructions to view known and predicted ranges of many species.

To see the protocol for conducting fall quail covey counts, visit *How Many Bobwhite Coveys Are There?* (Tall Timbers Research Station) at http://www.talltimbers.org/gb-autumnest.html

Appendix D. Alphabetical List of Web Links Listed in Tarheel Wildlife

Web links are time-sensitive and can expire. Find an updated list of Web links at www.ncwildlife.org/tarheelwildlife.

A Guide to Creating Vernal Ponds
http://www.fs.fed.us/r8/boone/documents/resources/vernal.pdf

A Landowner's Guide to Native Warm-Season Grasses in the Mid-South
http://www.utextension.utk.edu/publications/pbfiles/PB1746.pdf

Audubon
http://nc.audubon.org/

Beaver Management in North Carolina
http://www.ncwildlife.org/Wildlife_Species_Con/WSC_BMAP.htm

Bird Houses and Feeders: How to Build and Enjoy Them
http://www.ncwildlife.org/Wildlife_Species_Con/WSC_Publications3a.htm

Bobwhite Basics
http://seqsg.qu.org/seqsg/docs/bobwhitebasics.pdf

Breeding Bird Survey
http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

Butterflies in Your Backyard
http://www.ncsu.edu/goingnative/ag636_02.pdf

Certified Wildlife Biologists
http://joomla.wildlife.org/index.php?option=com_content&task=view&id=41&Itemid=245

Commercial Sources for Wildlife Planting Materials
http://www.ncwildlife.org/Wildlife_Species_Con/WSC_WPM.htm

Conservation Trust for North Carolina
http://www.ctnc.org/site/PageServer

Converting Common Bermuda Grass to Native Warm-Season Grasses
http://www.wildlifemanagement.info/files/nwsg_24.pdf

Crop Data Management Systems Agro Systems Data Base
http://www.cdms.net/LabelsMsds/LMDefault.aspx?pd=7602&t

Developing Wildlife-Friendly Pine Plantations
http://www.ces.ncsu.edu/forestry/pdf/WON/won38.pdf

Ducks Unlimited
http://www.ducks.org/

Eastern Bluebirds Nesting Structure Design and Placement
http://www.ca.uky.edu/agc/pubs/for/for52/for52.htm

Eastern Native Grassland Alliance
http://nativegrasses.utk.edu/enga.htm

Edge Feathering Job Sheet
http://www.mo.nrcs.usda.gov/technical/forms/out/wildlife_js/JS-BIOL-18EdgeFeathering_408.pdf

Effects of Management Practices on Grassland Birds: Field Sparrow
http://www.npwrc.usgs.gov/resource/literatr/grasbird/fisp/fisp.htm

Forest Landbird Legacy Program
http://www.fws.gov/nc-es/es/partners/factsheetlbl.pdf

Going Native Urban: Landscaping for Wildlife with Native Plants
http://www.ncsu.edu/goingnative/

Growing and Managing Successful Food Plots for Wildlife in the Mid-South
http://www.utextension.utk.edu/publications/pbfiles/PB1743.pdf

Handling the Fescue Problem
http://seqsg.qu.org/seqsg/docs/fescue.pdf

Homes for Wildlife II Plans
http://www.michigandnr.com/publications/pdfs/huntingwildlifehabitat/Landowners_Guide/Resource_Dir/Acrobat/Homes_II.PDF

How Many Bobwhite Coveys Are There?
http://www.talltimbers.org/gb-autumnest.html

Increasing Pine Plantation Wildlife Habitat and Recreational Value with Hub and Spokes
http://www.coontailfarm.com/documents/PDFs/PDFs2/Hub%20and%20Spokes.pdf

Longleaf Alliance
http://www.auburn.edu/academic/forestry_wildlife/longleafalliance/

Managing Pine Plantations for Timber and Wildlife
http://seqsg.qu.org/seqsg/docs/managingpine.pdf

National Wild Turkey Federation
http://www.nwtf.org/

North Carolina Cooperative Extension Service
http://www.ces.ncsu.edu/

North Carolina Division of Forest Resources
http://www.dfr.state.nc.us/

North Carolina Farm Service Agency
http://www.fsa.usda.gov/FSA/stateoffapp?mystate=nc&area=home&subject=landing&topic=landing

North Carolina GAP
http://www.basic.ncsu.edu/ncgap/

North Carolina Natural Resources Conservation Service
http://www.nc.nrcs.usda.gov/programs/

North Carolina Prescribed Fire Council
http://ncprescribedfirecouncil.org/

North Carolina Soil and Water Conservation Districts
http://www.enr.state.nc.us/dswc/

North Carolina Red-Cockaded Woodpecker Safe Harbor Program
http://www.ncwildlife.org/Wildlife_Species_Con/documents/nongame_rcw_landowners.pdf

North Carolina Wildlife Action Plan
http://www.ncwildlife.org/plan/index.htm

North Carolina Wildlife Federation
http://www.ncwf.org/

North Carolina Wildlife Resources Commission
www.ncwildlife.org

North Carolina Wildlife Resources Commission, Division of Wildlife Management
www.ncwildlife.org

North Carolina Wood Ducks Natural History and Management
http://www.ncwildlife.org/Wildlife_Species_Con/documents/WOODDUCK.pdf

NRCS Data Gateway
http://datagateway.nrcs.usda.gov/

Partners for Fish and Wildlife Program, U.S. Fish and Wildlife Service
http://www.fws.gov/raleigh/pfw.html

Quail Forever
http://www.quailforever.org/

Quail Unlimited
http://www.qu.org/

Quality Deer Management Association
http://www.qdma.com/

Red-Cockaded Woodpecker (U.S. Fish and Wildlife Service)
http://library.fws.gov/Pubs4/redcockadedwp02.pdf

Registered Foresters who Offer Consulting for Private Landowners
http://www.dfr.state.nc.us/Managing_your_forest/consulting_foresters.htm

Ruffed Grouse Society
http://www.ruffedgrousesociety.org/

Southeast Quail Study Group
http://www.qu.org/seqsg/

Tall Timbers Research Station
http://www.talltimbers.org/

Technical Guide to Crop Tree Release in Hardwood Forests
http://www.utextension.utk.edu/publications/pbfiles/PB1774.pdf

The Nature Conservancy
http://www.nature.org/wherewework/northamerica/states/northcarolina/

Upland Gazette
http://www.ncwildlife.org/Wildlife_Species_Con/WSC_Upland_Gazette.htm

USDA Service Center Locator
http://offices.sc.egov.usda.gov/locator/app

USFWS Ecological Services
http://www.fws.gov/nc-es/

USFWS Safe Harbor Program for the Red-Cockaded Woodpecker
http://www.fws.gov/ncsandhills/

Using Fire to Improve Wildlife Habitat
http://www.ces.ncsu.edu/forestry/pdf/ag/ag630.pdf

Using Plateau to Assist in No-Till Establishment of Native Warm-Season Grasses
http://www.uky.edu/Ag/Forestry/TBarnes/Assets/Plateau%20assist%20NWSG.pdf

Wildlife Damage Control NCSU Extension
http://www.ces.ncsu.edu/nreos/wild/wildlife/wdc/

Wildlife Diversity Program Annual Report
http://www.ncwildlife.org/Wildlife_Species_Con/documents/AnnualProgramReportWDinWM07-08.pdf

Wildlife Management for Missouri Landowners
http://mdc4.mdc.mo.gov/Documents/258.pdf

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1/10